AGRICULTURAL ENGINEERING

SEPTEMBER • 1955

In this Issue . . .

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AGRICULTURAL ENGINEERING

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RAYMOND OLNEY
Editor and Publisher

JAMES BASSELMAN
Associate Editor

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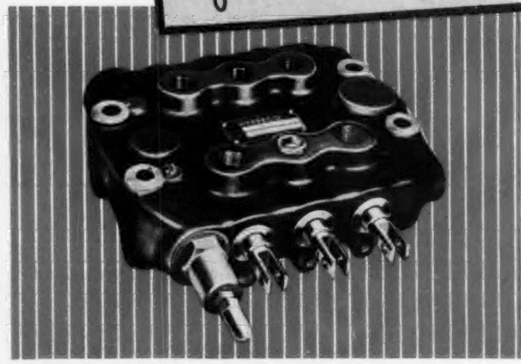

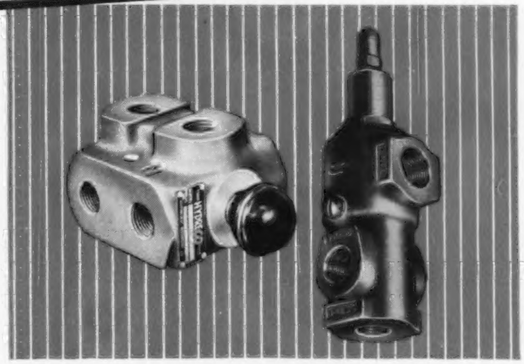

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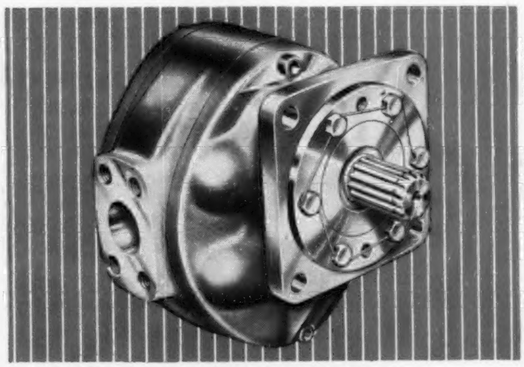

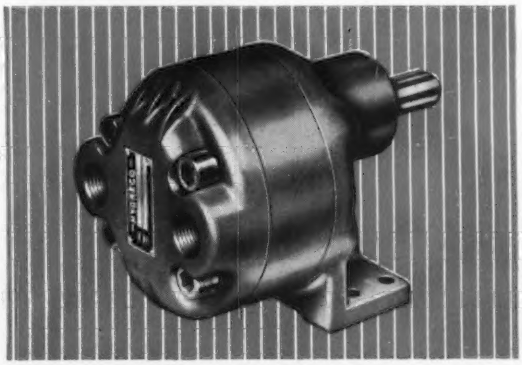

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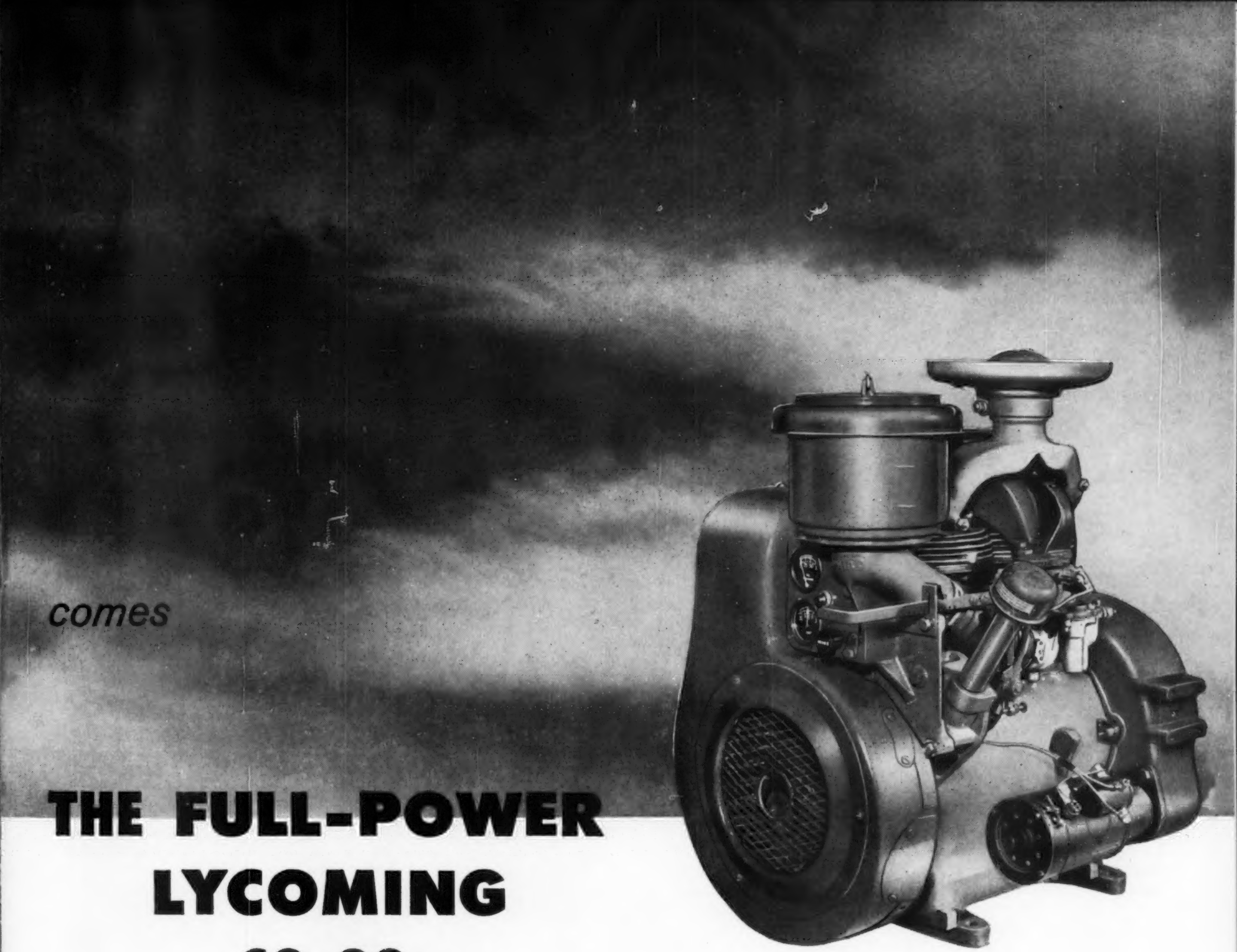

PHOTO COURTESY MASSEY-HARRIS-FERGUSON INC., RACINE, WISCONSIN

Chrysler-powered combines gather grain in record lots for dinner tables of the world

America's ability to produce grain is one thing, her ability to harvest all she plants is another. In any estimate of the size of America's breadbasket, therefore, the capability of modern harvesting machines is a large factor.

One of the big reasons America is always among the world leaders in the production of foods and foodstuffs is the modern self-propelled farm combine. And one of the most popular combines is the Massey-Harris. The "big red jobs" come in three self-propelled models, 60, 80 and 90 Specials. Widths of cut vary from 10 feet to 16 feet, grain tank capacities run from 35 bushels up to 60 bushels. But all self-propelled Massey-Harris combines have at least one thing in common—all are powered by Chrysler.

Take the smaller self-propelled 60 unit, pictured. It has an hydraulically-controlled cutting table with height of cut adjustable through 2½ inch to 32 inch range. Cuts a full 10 foot swath. The Model 60 Combine uses the Chrysler Ind. 30 Engine. This 230 cubic inch displacement engine powers cutting and separating components, and moves the combine along at speeds up to 14 mph.

Modern farm machinery requires modern high-speed power. That's why Massey-Harris, after exhaustive test, chose Chrysler Industrial Engines. They, like other manufacturers, found that Chrysler Engines are modern engines . . . lightweight, compact, capable of sustained high-speed performance at speeds higher than ever encountered in service. Result: manufacturers' equipment is powered for *maximum* performance.

Chrysler-installed optional equipment meets manufacturers' requirements too. For example, the manufacturer may select gasoline, natural or L-P gas burning carburetors; 3, 4 or 5-speed transmission; gýrol Fluid Coupling or the New Chrysler Industrial Torque Converter.

Check the equipment you buy or manufacture. If yours is not Chrysler-powered, see the nearest Chrysler Industrial Engine Dealer or write direct. And remember, Chrysler Industrial Engines are not expensive. Production-line methods adapted to specialized industrial engine building provide a custom-built engine at mass-production prices. ***Dept. 000, Industrial Engine Division, Chrysler Corporation, Trenton, Mich.***

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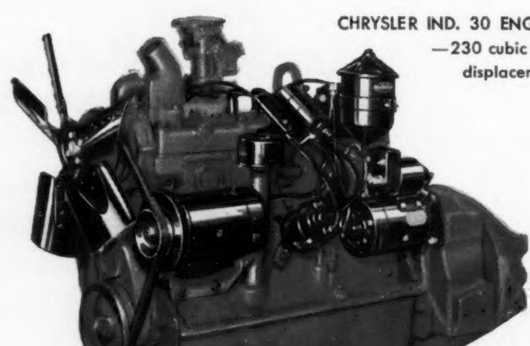
displacement



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Simplified design of new Lundell Implement employs Dayton V-Belts to gain maximum power

Combination Shredder and Hay Chopper, engineered with only 3 working parts, gets top performance through use of harder-gripping, Dayton raw-edge V-belt drives.

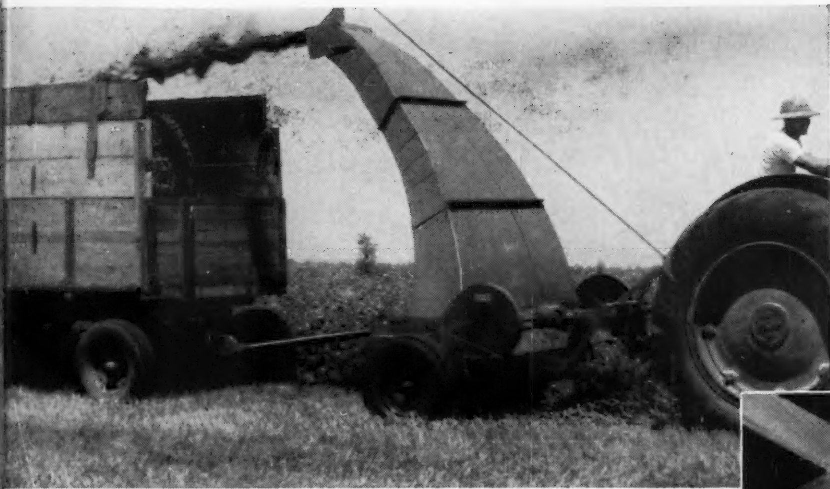
In developing this new combination unit Lundell Manufacturing Co. engineers parlayed design "know-how" and past experience into increased productivity at lower original and replacement cost.

Design "know-how" enabled them to build an implement, with only 3 working parts, that is setting new records in chopping hay, shredding stalks, chopping stalks and vines for bedding and preparing crops for silage. Result: a Combination Shredder and Hay Chopper which, because of its simplicity of design, costs less to buy, less to operate.

Past experience played an important part in developing the unit because of the success achieved by Dayton V-Belts on all other Lundell implements.

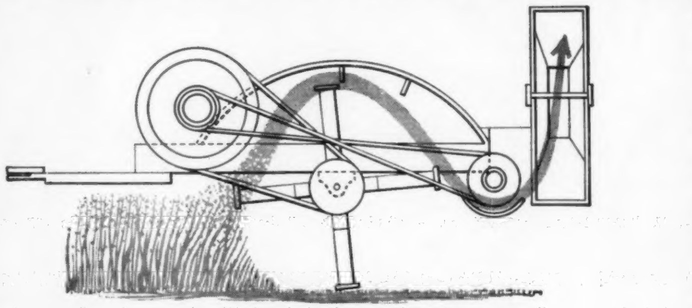
There was no need for Lundell engineers to spend weeks in research to find an adequate source of economical power. Dayton raw-edge V-Belts were installed as a matter of policy and proved their worth at once. The die-cut, raw-edge sides provided the necessary rubber-to-metal contact to grip pulley grooves tenaciously, hold on despite tremendous shocks under all conditions and deliver full power.

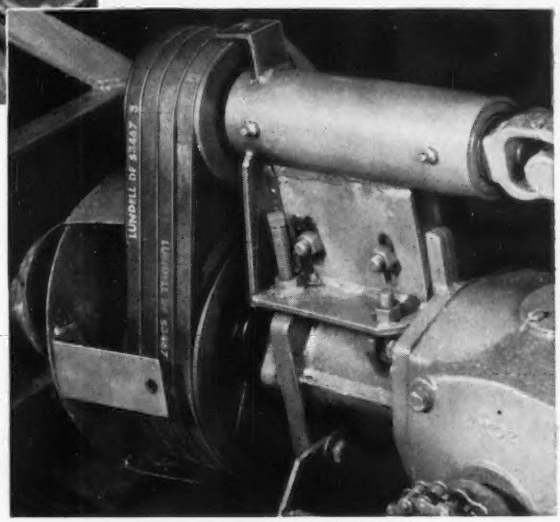
Photos courtesy Lundell Manufacturing Co., Cherokee, Iowa.



Lundell Economy Hay Chopper line also Dayton-equipped

Lundell engineers have given the same attention to power transmission on this Economy Hay Chopper by specifying Dayton Agricultural V-Belts for all drives. Designed and built to provide greater chopping capacity, this Economy Hay Chopper has an extra large throat area, wide cutting width and Dayton V-Belt-driven cutting knives.





Main cylinder drive

Four matched Dayton raw-edge V-Belts transmit an even, steady flow of power from the take-off shaft to the main cylinder. Two matched Daytons drive the cylinder equipped with hammer like knives for cutting and chopping and a second set powers the auger or blower.

Dayton V-Belts provide *extra* power

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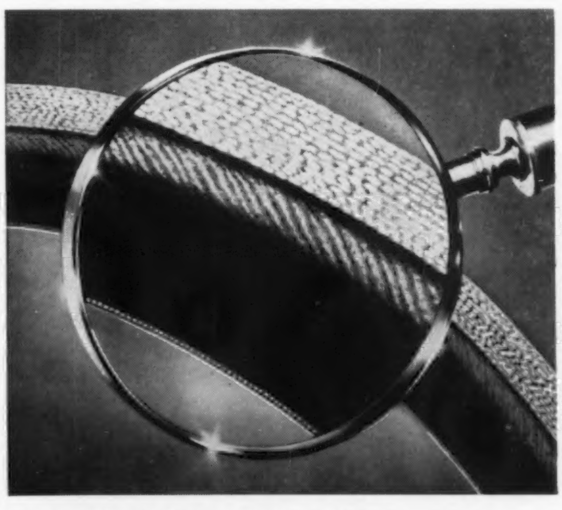

Dayton V-Belt has exclusive features

This die-cut, raw-edge Dayton V-Belt provides perfect rubber-to-metal contact, without slippage, due to high coefficient of friction. Ruggedly constructed, the load supporting members extend the full width—from one side of pulley to the other.


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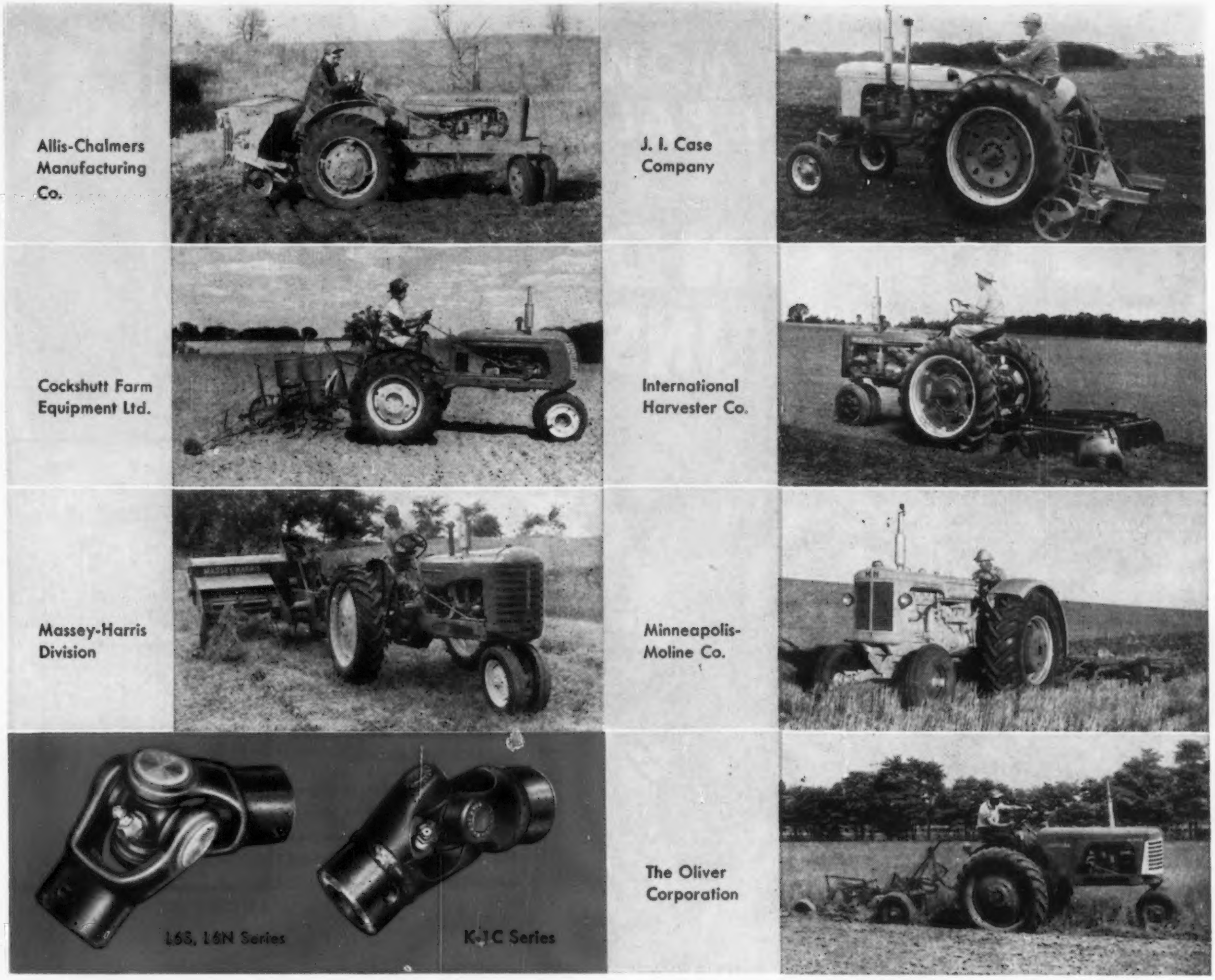
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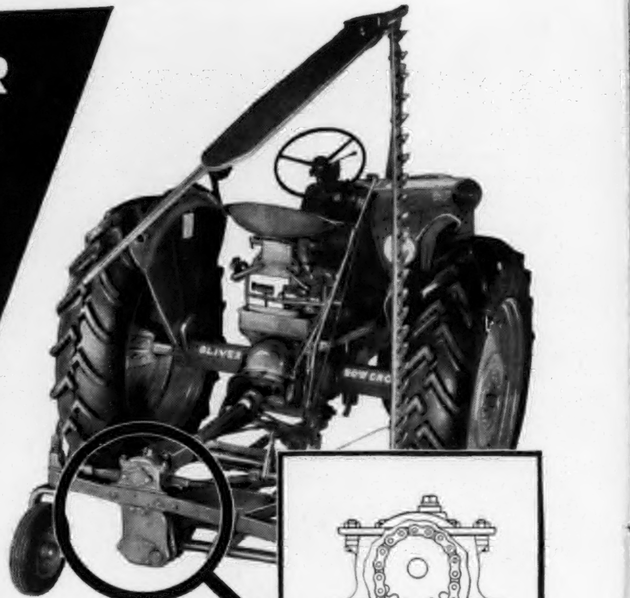

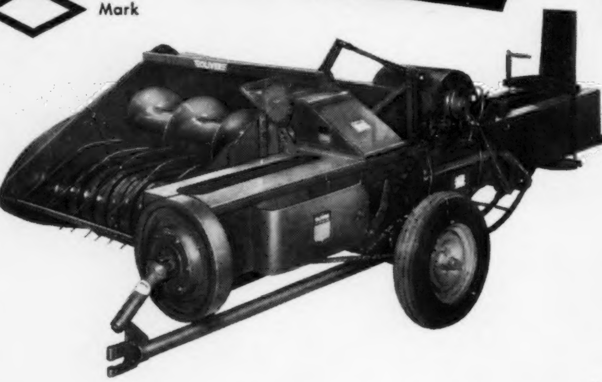

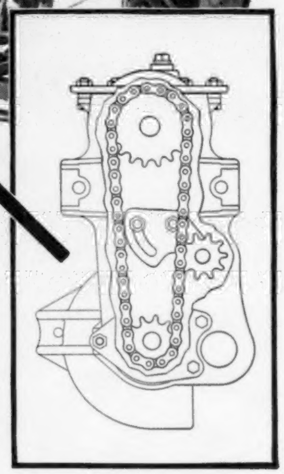

Drawing shows Diamond Roller Chain drive from power take-off shaft to cutter bar of Oliver Mower.

On the Oliver Baler, Diamond Roller Chain supplies power from the main transmission for many of the machine's operations.

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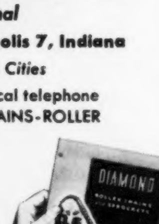
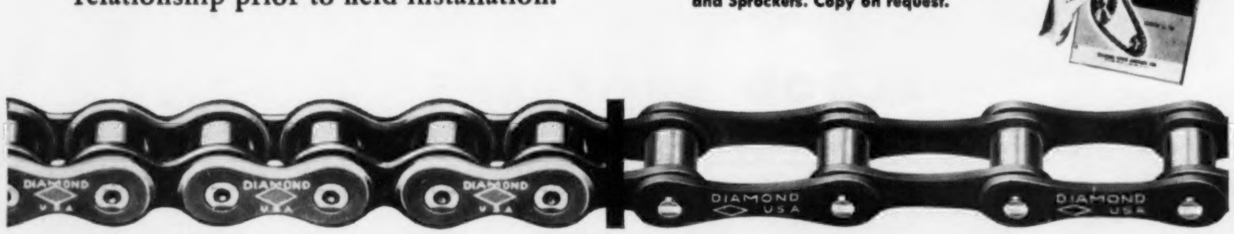
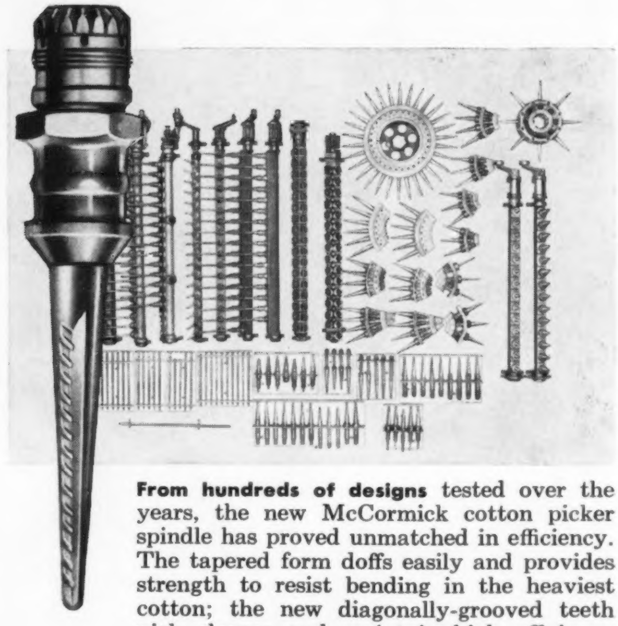




A report to you about men and machines that help maintain International Harvester leadership

How IH engineers "buried" the barbs to make

New Spindles pick cotton cleaner and last longer



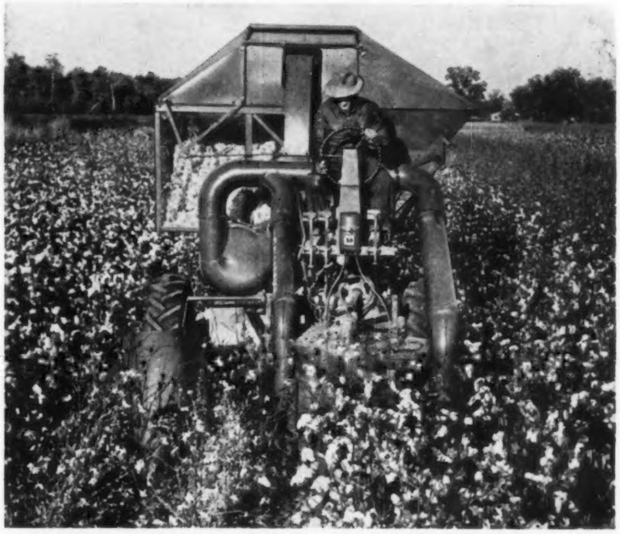
From hundreds of designs tested over the years, the new McCormick cotton picker spindle has proved unmatched in efficiency. The tapered form doffs easily and provides strength to resist bending in the heaviest cotton; the new diagonally-grooved teeth pick cleaner and maintain high efficiency much longer.

The tapered, barbed spindles developed for McCormick® cotton pickers through 35 years of engineering research set an unmatched record for efficient cotton picking. But Harvester engineers did not rest on success.

Research continued—and produced an improved design having three rows of teeth cut *into* the chrome-plated spindle. Thus, teeth tips form part of the spindle circumference, eliminating protruding barbs, yet creating teeth that maintain their aggressiveness for a longer period of time. Cotton is picked without tangling and distorting the fibers. Doffing is cleaner, because the doffers can be set closer to the spindles. Both spindles and doffers maintain peak picking efficiency for double the number of bales.

Three years of field experience have proved the ability of these new spindles to assure high efficiency under the widest range of picking conditions, even when pickers with other types of spindles have to pull out of the field. Differential in grade between hand and machine-picked cotton is reduced still further.

All current McCormick cotton pickers are equipped with these lower-cost, more efficient spindles. They also may be installed on any older model McCormick picker now in use.



Picking only 40 bales a year enables a low-drum McCormick 2C-14 Cotton Picker mounted on a Farmall 200 tractor to pay for itself in use. For larger acreages, there is the McCormick 34HM-114, a low-drum picker that mounts on Farmall 300 and 400 tractors. A high-drum model for tall, high-yielding cotton, the McCormick 4M-120, mounts on Farmall 400 series tractors.

IH engineering teamwork made possible the mechanization of cotton harvesting. Continued research and development on the part of IH research, engineering, and manufacturing men have raised mechanical picking efficiency to new, high levels. The unmatched performance of the new McCormick spindle is an example.

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He and his men have invested many years and dollars in producing more and better farm land . . . you can borrow from that experience. The Caterpillar Dealer near you is a good man to know!

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR*

LOOK TO YOUR CAT DEALER FOR LAND IMPROVEMENT EQUIPMENT

AGRICULTURAL ENGINEERING

VOL. 36 | SEPTEMBER, 1955 | No. 9

The Outlook on Farm Building Design

William H. Yaw
Affiliate, ASAE

The owner of a farm clinic service discusses farm building trends and makes some suggestions for future design and development in line with efficient land-use and livestock programs

IN TODAY'S changing agriculture, pressure is increasing for further changes in farm building design, construction and lower costs. Gradually, use value is getting more attention than insurance value and replacement value. More and more buildings are being viewed in the light of the amount of labor they can save and how the building lends itself to keeping fertility on the farm.

Economically the depreciation on a farm building is considered as rent paid by the grain, machinery or livestock housed therein. If a building does an optimum job of conserving and developing the resources it houses, the rent becomes a small item in the farmer's cost of production. Buildings also must allow for the greatest flexibility of operation. Consequently farm buildings become a part of the farmer's plan of operation.

Before considering the place of farm buildings in a farming or ranching operation, a good land-use and livestock program must be developed. Farmers more and more are learning that those farming operations, which build up the fertility of the land while at the same time make a reasonably good profit, survive over the years.

A successful farmer must build up his soil and his bank account together. Increased yields of crops do not necessarily mean that either is being done. Increased income comes from mass production per farm and mass performance per man, irrespective of the size of the farm. The net farm income, of course, is the important figure to which the two foregoing points heavily contribute.

Increased fertility together with increased income means building up the organic matter, returning to the soil all crop residues and replacing minerals removed by crops, leaching and erosion.

With few exceptions, the initial soil tests on farms, which our firm, The Farm Clinic, West Lafayette, Ind., has been consulted for farm development, reveal that the only adequate supply of nitrogen, phosphorus and potash is concentrated around the farmstead, under the trees, or has escaped through the drainage systems. This has caused our advisors to emphasize the rotation of livestock around the fields with the crops. This is especially true with beginning farmers where resources are limited.

An item not to be overlooked is the value of proteins from animals. Diets of our rapidly rising population heavily favor more protein production.

Roughly three-fourths of the feed consumed by livestock, when properly handled, becomes fertilizer. Livestock farming, therefore, has a double advantage of making money each year and lowering the following year's fertilizer costs. This is important anytime, but especially when farm income is down and costs are up.

Livestock buildings should be adapted so that they lend themselves to the movement of livestock around the farm. By permitting the livestock to feed themselves, a man is able to spread his labor farther—allowing him to enlarge his operation in many cases.

Buildings to Fit the Land-Use and Livestock Program

Farm buildings seem to be developing in two widely varying directions at the same time. The first is the highly specialized type where buildings are used essentially for one

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Urbana, Ill., June, 1955, on a program arranged by the Farm Structures Division.

The author—WILLIAM H. YAW—is co-owner, The Farm Clinic, West Lafayette, Ind.

Flexible-type buildings, designed with labor saving and use value built in, are supplementing and in many cases replacing the existing, often overdesigned, farm structures

purpose. These can be justified only when the enterprise is developed sufficiently and is large enough to warrant the overhead of such a structure. The second is the flexible type where the building is nothing more than a shell which can be adapted for a wide variety of uses, even to the point of making the shells movable.

In the development of either type of building, the bulk handling of feed, bedding and manure must be considered. If possible, one should eliminate handling the manure and let the livestock spread it themselves. Much emphasis is being given to ground-level storage and self-feeding by the animals.

Many manufacturers have been instrumental of late in developing flexible, stationary buildings of the second type for housing machinery, livestock and roughages. The pressure-treated pole buildings are a step in this direction. As seasonal needs vary these buildings can be adapted to any of the three requirements. The emphasis is on large open interiors where high machinery can be stored and substantial quantities of roughage, particularly chopped or baled hay, can be stored. The ground level is kept unobstructed for quick mechanized cleaning after livestock.

Once the land use program is set up, our first job as farm consultants is to adapt existing facilities to their best use. Outmoded farmstead establishments can be converted into grain-storage and processing centers or machine-storage and repair centers. If an old open barn or shed is available or can be converted, it can be supplemented with portable buildings for hogs, sheep or beef cattle so that greater numbers can be handled.

Our firm feels that there is a real need for a highly developed grain-storage and processing center. We like the idea of horizontal movement of feeds, using simple elevators and screw conveyors which require electric motors. There is room for development of a system in which the various components, such as individual bin storage, burr or hammer mills, mixers, dryers and continuous conveyor systems, are added one unit at a time.

Machinery storage and repair, especially an on-the-farm repair center, needs development along the same lines as the grain-handling center mentioned above. This should not be too elaborate. Above all, both should be developed on a plan permitting addition of increments at a time as they can be paid for.

Farm structures requirements vary widely due to climate in the country's main areas. There is evidence that, with respect to livestock, considerably more work needs to be done in protecting animals from excessively high temperatures. In northern climates there is considerable evidence that costs of production and losses are too high due to excessive protection from winter weather hazards. Notwithstanding climatic variation in various parts of the country, there is still room for considerable simplification and standardization of farm structures.

During inclement weather unobstructed interiors of older buildings, the modern treated-pole frame structures, or the many prefabricated steel buildings offer some practical solutions for handling livestock. Providing shade and shelter for livestock in the fields seems to be a big problem.

We like to keep livestock out on pasture during as much of the season as possible. Livestock wait on themselves more, they spread the manure automatically, and it saves on the protein and fertilizer bill. Also, the sun and rain seem to minimize disease problems.

For hogs we like a two-pen house which can be shoved together to make a four-pen unit with an alley in the middle. These four-pen units can be shoved end to end to simulate a central farrowing house in cold weather. We would like a concrete radiant-heated slab to set these houses on when they are grouped for central farrowing in inclement weather. The slab is the only fixed installation needed for hogs. The houses could be pulled up on the slab, banked with manure and bedded with corncobs.

The electric heat lamp on the concrete floor does not seem to provide the proper heat. Perhaps electrically-heated rubber mats could be used effectively. Public Service Company of Northern Illinois has done some work on concrete pallets containing heating cable. Here is an area where some creative engineering could render a real service.

In the fields we separate these houses into two-pen units. They are set up in courts for mass handling of pigs until weaning. Also, they are used when weanling pigs are grouped into pens of 50 to 75 in legume pastures, and equipped with ear or shelled corn self-feeders and waterers. This is one way that feed and fertility are kept out on the land. We increase the number handled per man and reduce the labor load.

For beef cattle and sheep we like a portable shed with an overhang similar to the one described for hogs. These sheds can be pulled up on a blacktop or concrete slab around a feed-processing center or adjacent to an open-type shell building in the winter. In the spring, summer and fall these buildings are moved off the slabs into pasture fields.

For dairy cattle it seems to us that Hervey Research Development Corp. has made a real contribution in a streamlined milking center which can be adapted to existing farmsteads at low cost. This separate parlor and bulk-tank addition enables one man to handle more cows in less time, thereby lowering his costs of production.

The subject of handling roughages is getting much attention. This is best handled by supplementing existing upright silos with some type of self-feeding trench silos or stacks. The self-feeding trenches or stacks seem to offer the best opportunity to spread labor and save roughages.

To supplement upright silage supplies, stacking silage outside and feeding it with an electric wire from November through January where the ground is frozen has given excellent results.

This is, of course, only on those farms where good upright silos are already intact. Where we start from scratch in silo construction, best results seem to come from laying a concrete slab and lining two sides with creosoted boards braced by railroad ties. A self-feeding gate is used to feed out the silage. Costs are reasonable and silage seems to remain in excellent condition. There are also some rather efficient concrete-lined trench silos from which we self-feed.

With hay we have good success stacking excess quantities of bales in the field like a gabled roof. They are sometimes covered and with right types of bales in limited moisture areas; covering is unnecessary.

Improved Flexibility of Buildings

The question arises as to how to increase flexibility of building design to provide for increased farm production under good land-use management.

There appears to be too much "cut and fit" in portable

hoghouses and cattle sheds. It seems that some light, sturdy wood or metal panels could be developed. They could be produced on some type of assembly-line basis and shipped knocked down to the farmer for assembly. Perhaps a light, aluminum alloy or the cornstalk panel, Purdue agricultural engineers are working on, could be used. It might be possible to design a single unit which with the same dimensions could handle either lighter beef cattle (up to 1000 lb), hogs or sheep.

These flexible, movable buildings should provide better shade than a tree. Trees concentrate fertility on land where crops can't grow.

Buildings should be built with flexible panels which could be swung out at right angles to their normal position. Perhaps a base building unit could be built at minimum cost and expanded a panel at a time, as the farmer could afford it. This might be adapted to pole-frame or light, aluminum-type alloy construction. Furthermore, it might be designed so that panels fit together without nuts, bolts or screws.

A lot can be done toward cutting building costs by simplifying erection. During certain seasons of the year farmers have a sizeable amount of time on their hands. If buildings could be put together by them in short spurts of time, construction savings could be effected and the farmer might be more interested.

An emergence of quite a skillful young class of tenant-managers has developed recently. In many cases these men prefer to rent a good tract of land and to invest more of their resources in operating equipment instead of buying land. They need buildings to expand their livestock operations. Many absentee owners don't want to make the building investment. If more attention were given to this movable building idea, they possibly could be financed on a flexible plan.

Cameron Hervey has touched on this principle in his milking parlors. His parlor and bulk tank are produced as a separate entity to be fitted into existing farmstead conditions. A considerable proportion of his milking parlor is movable. When the tenant leaves a farm, he can take the equipment with him.

The number one item in every respect should be the farm residence. Frequently the wife is the key to the whole operation of successful rural living. She is the one around which greater community, social and religious life centers. If she is greatly dissatisfied, the family "ship of agriculture" sinks and the family moves somewhere else.

We are inclined to favor setting up new dwellings apart from the commercial establishment on the farm. We favor putting a little stress on the beauty of rural living. It can still be simple and realistic. The efficiency can be stressed by an office at the commercial site and a bunk in the hoghouse at farrowing time.

Mechanization of Mushroom Farming

THE Knaust Mushrooms, Inc., Valmeyer, Ill., picks and ships 2000 lb of mushrooms every day of the year by utilizing power equipment in a most interesting farming operation.

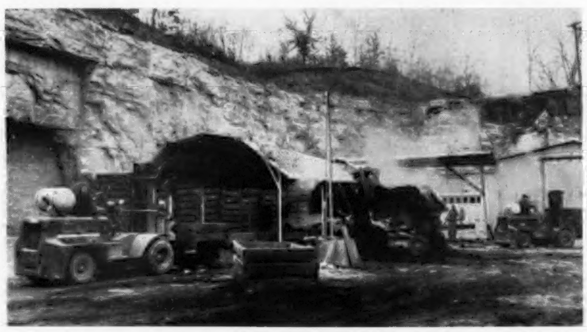
When young, imaginative Henry Knaust entered the mushroom business four years ago, he chose as his farm 110 acres of abandoned limestone quarry. The long, 50-ft-high quarrying tunnels supplied two essential conditions for successful mushroom raising; darkness and a constant cool 55 F temperature. He also planned methods which would allow a maximum of mechanized handling rather than usual manual methods.

As the nucleus of the handling equipment, a fleet of three Clark yardlift fork trucks of 6,000-lb capacity were purchased and modified to meet the special requirements of the operation. The trucks were adapted to operate on LP gas and were equipped with hydraulic drive.

The first farming operation is filling wooden trays with chemically-treated compost. (See pictures below.) The trays measure 4 ft by 8 ft by 6 in. Filling is done at a conveyor. A fork truck sets the trays at one end of a belt conveyor. At the end of the conveyor the filled trays are lifted off the belt by a fork hoist and set on an adjacent platform. A second fork truck carries 4 or 5 trays per load to a steam shed, tiering the trays 13 high. Trays remain in the shed for 10 days at temperatures ranging from 110 to 160 deg.

After curing, trays are returned to the conveyor for the "spawning" operation, in which mushroom seeds are planted. Seeded trays are fork-trucked into the cool, dark tunnels and deposited in spawning rooms, where they are left to incubate for 3 weeks. At the end of the incubation period trays are removed four at a time by fork truck to the "casing" station where dirt is added and spread evenly to a thickness of 1 in.

When 4 trays have been "cased," the fork truck carries them to the "setting" rooms. This is the last stop in the cultivation process. Here the mushrooms reach maturity and are picked over and over again for a period of 6 to 8 weeks. Here trays are set in a checkerboard pattern; that is, each tray rests on the sides of the two trays beneath it, similar to the squares of a checkerboard. This is done to conserve floor space while still keeping each tray accessible for picking.



V-Belt Drives for Farm Machines

C. J. Scranton
Member ASAE

TWENTY years ago there were only a few applications of V-belts on farm machines. At that time, power drives were accomplished by flat belts, link chains, roller chains, and gears. Today, due to improved techniques in manufacturing, availability of better materials, and improved construction, the V-belt is rather widely used on farm tools. V-belt drives are usually of the single-strand type, but in some cases where power-transmission requirements are high, multiple-strand drives are also used.

V-Belt Drive Types

The use of the V-belt drive combines flexibility with quiet running and has solved many problems on agricultural machines where the designer of the drive has thoroughly understood the scope and limitations of application. Some of the advantages of V-belt drives follow:

- A single belt can drive several units on a mcahine because it can be wrapped around several sheaves on different shafts. If the conventional belt does not accomplish the results, the double-V construction is available.
- V-belts can be crossed so that direction of shaft rotation will be reversed.
- The V-belt can be used as a clutch by pressing the belt in the sheaves with an idler.
- The V-belt drive can be so designed that slippage will occur at overloads and thus act as a safety clutch.
- The belt can be used for variable-speed drives by merely changing the sheave opening with shims or mechanical means which change the pitch diameter of the sheave.
- The belts are available in several cross-section sizes for transmitting a wide range of horsepower.

The Reason for a Standard

The large number of manufacturers of V-belts and the great variety in design and construction over many years led to confusion with respect to exact standards on cross sections, the method of determining the belt length, the tension under which the belt was to be measured, and other details affecting the belt application. These variations led to misunderstandings on the part of both manufacturers and users and called for a complete re-evaluation of the whole belt program, so that the supplier, implement manufacturer, and the final customer could be better served.

A standard, "V-Belt Drives for Farm Machines," sponsored by a joint committee representing V-belt and farm machinery manufacturers, was approved and adopted by the American Society of Agricultural Engineers in June, 1950. The standard is now in general use by all manufacturers of V-belts, designers of farm tools, and the inspectors at the various farm implement manufacturing plants. The result has been a much better understanding of the manufacturing limits and uses of V-belts by all persons concerned and has resulted in a common language with respect to their general application, use, and measurement.

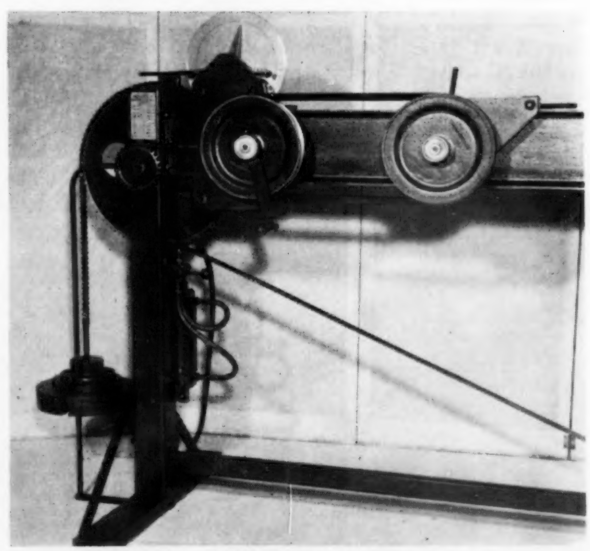
Nature of the Standard

The following items became part of the standard:

- Five section sizes of V-belts which operate interchangeably in standard dimension grooves
- Four standard sections of double V-belts
- Four standards of adjustable-speed belts
- A method of determining the effective length of the belt
- A list of production belt sizes and available lengths
- Groove dimensions for V and double V-belts
- Allowances for variation in manufacturing of the belt, installation of the belt, and take up for stretch and wear
- Minimum diameters of idlers

What the Standard has Accomplished

- The manufacturer of the belt and the user now use the same data in measuring belts. That also applies to inspection departments.
- The designers of farm equipment now have data for the proper design of V-belt drives.
- Adequate allowances were established by the standard to take care of initial application, stretch, wear and shrinkage. The result has been better design for installation and take-up of V-belts.
- All manufacturers of farm equipment use a similar measuring machine (see accompanying illustration) for cheking the manufacturing limits of V-belts.
- The number of belt lengths and types have been reduced.
- Sheave angles have been standardized.
- The simplified program has guaranteed that replacement belts will fit the drive.



Typical V-belt measuring machine

The author—C. J. Scranton—is chief engineer, La Porte Works, Allis-Chalmers Mfg. Co., and a member of the Farm Equipment Institute advisory engineering committee.

Offset Disk Harrow Design

R. W. Kramer

A thorough analysis of the factors involved in the design of an offset disk harrow in respect to function, cost and appearance

THE designer of almost any item must base his design on three major considerations — function, cost and appearance. Various products will require that varied emphasis be given these three factors; in farm implement design their importance is generally in order listed.

A product, in order to perform a given function, must be so constructed that it will provide adequate durability for the job as well as provide a means by which the function will proceed smoothly.

Intelligent design for durability requires that a study of involved forces should first be made.

Disk harrowing involves tilling the soil by moving a disk through it. A disk having some dish to it has been found to produce generally better results. In operation it is oriented with the plane of its cutting edge at an angle to the line of travel so that the dirt will be turned and broken up and moved up to the side as the disk passes. Thus the soil forces on a disk tend to push it to one side as well as resist its moving ahead through the ground.

A disk harrow consists of two or more gangs of disks. A common arrangement, known as a tandem disk harrow, is shown in Fig. 1. In this implement two pairs of gangs are used with the members of each pair mounted directly opposite each other. The resultant of the force of the soil on the blades of a gang acts approximately in the position and direction indicated by the gang force, F_g. This gang force may be considered as consisting of components F_s and F_l, acting to the side and longitudinally as the harrow moves along. In this type of harrow all the side forces, F_s, acting on one gang can be balanced directly by corresponding forces on the opposite gang.

Offset Disk Harrow

A disk-gang arrangement which is gaining wider acceptance is shown in Fig. 2. Two gangs are located one in front of the other. The side force, F_s, acts to the left on the front gang and to the right on the rear gang. If the harrow is to be pulled without exerting any side draft on the tractor, then the side force acting on the front gang must be numerically equal to that acting on the rear gang. This case is shown in the illustration.

The laws regarding forces state that, when a system of this type is in balance, its forces must intersect at a common point. Thus, by knowing the location and direction of the resultant forces of the soil acting on the gangs, F_g, a point can be located through which the draft force, F_d, must pass. Since the gang forces, F_g, intersect to one side of the geometric center of the harrow, then the draft force, F_d, must be offset from the geometric center.

This means that, when the harrow is running without side draft on the tractor, it is tilling a strip of ground, the center of which is offset from the center of the tractor. An implement of this type has come to be known as an offset disk harrow. One which offsets to the right of the tractor is a right-hand offset disk harrow. A combination arranged so that the gangs angle open to the left would naturally offset to the left and is referred to as a left-hand offset disk harrow.

Operating Forces

The design problems encountered with offset disk harrows are complicated by the fact that the front and rear gangs must exert balancing forces, even while working in soils of differing consistency.

While the line of the draft force must intersect the lines of the gang forces when viewed from the top, these forces do not intersect when viewed from the level of the implement. The gang-supporting structure, by necessity, must be above the ground level while the center of resistance is below the ground.

View *A-A* of Fig. 2 shows the effect of this vertical displacement on a single gang. The portion of the gang force,

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The author—R. W. Kramer—is product designer, International Harvester Co., Stockton, Calif.

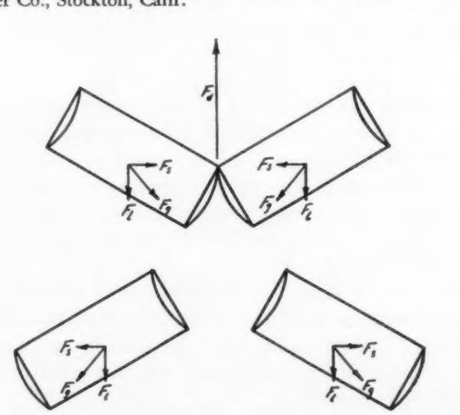

Fig. 1 Operating forces acting on a tandem disk harrow

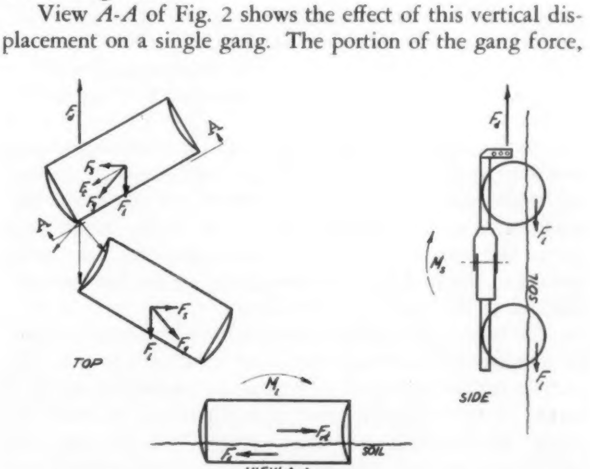

Fig. 2 Operating forces acting on an offset disk harrow. View A-A shows a moment caused by thrust forces below ground and forces to resist thrust above ground. Side view shows unbalanced forces caused by location of hitch point above ground and soil forces below ground

F_g, which can be considered to act in a direction parallel to the gang axle, has been termed the thrust force, F_t. This force will be applied to the blades below the ground surface whereas the force, F_{rt}, to resist this thrust, must be transmitted to the blades at the gang axle. These two forces create a moment, M_l, about a generally longitudinal axis, which tends to make the gang run deeper at its concave end and shallower at its convex end.

The rear gang must provide a longitudinal moment, M_l, which will balance the M_l of the front gang, as well as balancing the side forces, F_s, if the machine is to operate level and without side draft.

Looking at the harrow from the side reveals another couple which tends to unbalance the machine. Here again the draft force, F_d, must be above the ground whereas the longitudinal portion, F_l, of the gang force which resists the draft is applied below the ground surface. The resulting moment, M_s, tends to transfer the center of gravity of the implement toward the front gang.

The direction of the gang forces, F_g, is dependent on the ratio of the side force to the longtitudinal force on a gang. This relationship will vary depending on a number of factors, such as blade size and concavity, depth of penetration, cutting angle and operating speed. Any change which results in increased bearing on the back side of the blade will tend to decrease the side force in proportion to the longitudinal force, and conversely. Increases in operating speed have been found to increase the side force because the dirt is thrown farther.

Changing the direction of the line of action of the gang forces will change their intersection point, and thus change the amount of offset which is required to eliminate side draft.

Besides this normal or no-side-draft offset position, the offset disk harrow is capable of being pulled with the center of its cut in an infinite number of other positions over a wide range with respect to the center line of the tractor.

If the hitch point of the implement is moved to the left of the no-side-draft position of the draft force, F_d, the result is that the harrow is pulled around so that the cutting angle of the front gang is decreased and that of the rear gang is increased. Under these conditions the side force to the right on the rear gang is greater than that to the left on the front gang and the harrow assumes a position which is offset farther to the right than the no-side-draft position.

The portion of the side force of the rear gang which is not balanced by the front gang must then be balanced by the tractor.

On the other hand, if the hitch point of the implement is moved to the right of the no-side-draft position, the cutting angle of the front gang is increased and that of the rear gang decreased. The added side force on the front gang moves the harrow to the left. Here again the unbalanced portion of the side forces of the ground on the harrow must be borne by the tractor.

The farther the harrow is moved in either direction from its no-side-draft position, the more difficulties can be expected. Imposing side draft on the tractor usually makes it harder to steer and may lead to increased maintenance expense. At the same time it becomes difficult to leave the field level because one gang, having significantly more angle than the other, will move more dirt.

Originally offset disk harrows were used in orchards where their natural offset was a desirable feature, enabling an operator to cultivate under the trees and yet run the tractor out in the open. In more recent years these tools have shown advantages for open field tillage. By having one gang behind the other it thoroughly works the soil and puts it back where it came from so that there is virtually no net shift of the ground to one side or the other as it is being worked. The tandem disk harrow will do this also, but it may leave an unworked ridge in the center of the cut and it leaves a furrow on both sides of the cut.

An offset disk harrow, on the other hand, disks all the ground over the full width of the cut. It can be operated so that the one furrow which it leaves on one side of the cut can be filled on the next pass. In addition, having less parts it will be generally less expensive to build than a comparable tandem disk harrow of the same size.

This matter of filling the furrow does, however, present additional problems for the designer. A right-hand harrow leaves a furrow on the right side of the cut. In order to fill this furrow, succeeding passes should be made on the right side of the previously disked ground. This frequently means that the harrow must be moved to the left of its no-side-draft position in order to cut out the left tractor track. In some conditions offsetting the harrow creates sufficient unbalance between the front and rear gangs that it may become difficult to leave the field in a desirable condition.

Controls

In addition to the design requirements imposed by the forces present there are a number of controls and adjustments needed to enable the disk harrow to operate efficiently over a wide variety of conditions. One of the most important of these is some means of moving the disk harrow from one job to another.

Two methods are in general use for this purpose. Some units are hinged so that their gangs can be swung parallel to each other. In this position the blades roll on top of the ground rather than digging in. In other cases some means is provided for lifting the gangs out of the ground. Some of the hinged type utilize a hydraulic cylinder to change the angle between the gangs. For other models the pull of the tractor is used directly against the ground resistance on the gangs.

Disk harrows which are designed to lift out of the ground may either carry their own wheels for this purpose or they may be lifted by means of a tractor hitch. Units which carry their own wheels seem, for several reasons, to offer more challenge to the engineer than the other types. Providing mountings and controls for the wheels in the center of the harrow tends to restrict dirt passage. Also, moving the gangs far enough apart for proper functioning of a wheel on the left side of the implement makes its more difficult to achieve the desired operating balance between the front and rear gangs. This is because moving the gangs farther apart moves the point of intersection of the gang forces farther from the geometric center of the machine. Thus it becomes more difficult to cut out the left tractor track, as previously described.

On the other hand, the direct-connected lift-type harrow is about the easiest with which to work. Being held in position by the tractor it becomes possible to independently adjust offset, relative penetration and the relative cutting angle of the two gangs.

The major problem encountered with direct-connected

disk harrows is that they must be made light so that they can be carried, yet they need to be heavy in order to obtain satisfactory penetration. As a solution a double-acting cylinder in the tractor lift is used by one manufacturer to transfer weight from the tractor, where extra weight can be added if necessary, to the implement.

Adjustments for Soil Conditions

It was pointed out earlier that a forward shifting of the center of gravity of the implement generally occurs in pull-behind harrows because the point at which the drawbar pull acts on the machine (the hitch mounting) is above the level of the ground reaction.

In hard ground conditions this shift may be desirable and the hitch mounting purposely made high because the ground encountered by the front gang is harder than that encountered by the rear gang. In other fields the soil will be more mellow, requiring a lower hitch mounting. In order to meet these varied conditions some means should be provided for changing the level of the hitch mounting.

Getting the rear gang to run in the proper lateral position with respect to the front gang has always been a matter of major concern with offset disk harrows. At one time it was considered that the front gang would always leave a tilled profile something like that shown by the heavy lines in Fig. 3*(a)*. In fact, when speeds were slower and penetration was generally less, it is probable that uncut ridges, as represented by the shaded area, were often left. Under such circumstances the gangs were often adjusted so that the blades of the rear gang would cut out the ridges left by the front gang. This position for the blades of the rear gang is shown by the lighter lines in Fig. 3*(a)*.

Offset disk harrows are used more commonly these days as a primary tillage tool rather than merely for a finishing operation. As such they are used at deeper penetrations, which means that any irregularities which may occur becomes less significant.

At the same time, the greater power available today permits higher working speeds. Observations have indicated that, because of these factors, in normal ground the soil seems to tear across from the bottom of one blade to the bottom of the cut of the preceeding blade as indicated in Fig. 3*(b)*. These higher speeds also throw the dirt farther.

The combination of these effects usually makes it more important that the rear gang set over farther to the right in order to be able to pick up the soil displaced by the front gang and move it back to the location from which it came. The exact position which is correct for the rear gang will depend on the ground condition, the size and shape of the

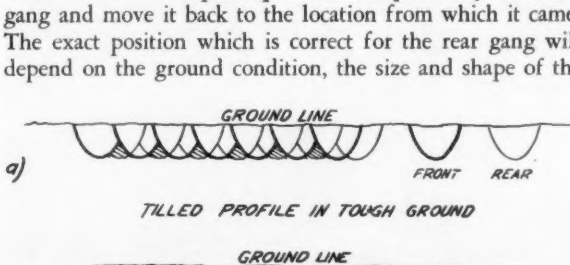

Fig. 3 *(a)* Heavy lines indicate path of front gang in tough ground. Shaded area represents area that would be left untilled if rear gang (indicated by light lines) did not trail properly. *(b)* In normal ground, especially at high working speeds, soil will tear across from the bottom of one blade to the bottom of the next

disk blades, cutting angles of the gangs and other operating variables. The usual practice is to provide a range of adjustment so that the harrow can be set to work properly in whatever conditions it encounters.

Components

Having reviewed the basic forces which are encountered and the adjustments which are needed to adapt the implement to a wide variety of conditions, some of the major components which are needed in a disk harrow should be considered.

The frames of offset disk harrows used primarily for orchard work were kept low to permit the implement to operate under the trees without catching on the lower limbs. However, machines which are used for open-field tillage, need to have higher frames moved forward so that dirt and trash can pass freely.

Bearings between the blades and the frames present an interesting design problem because these bearings run right down in the dirt. Consequently a bearing must be capable of continued operation under abrasive conditions or else provision must be made to effectively exclude the dirt from the bearing surfaces.

The bearings must also be able to handle thrust loads which are often greater than the radial loads. It has been found that they generally will perform more satisfactorily if they are mounted so as to permit some freedom, to allow for deflections of the gang axle and frame during operation.

Four general types of bearings have been or are being used extensively for disk harrows. Some of the first used either hard, cast white iron or oil-impregnated wood as the bearing surface. The hard iron resists abrasive action remarkably well, but if it becomes dry it squeaks very disconcertingly. The oil-impregnated wood, on the other hand, effectively eliminates the noise, but if the soil is at all abrasive it wears out the wood in rather short order.

The first successful designs of bearings sealed against dirt included bearing sleeves in a tubular housing which turned on a shaft. The blades and spacer spools were mounted over the housing. An oil bath inside the housing circulated over the bearings in much the same manner that oil circulates over the gears in a transmission. This oil-bath-type axle has long been accepted as the standard and still is used extensively.

More recently anti-friction bearings, both ball and roller, have been mounted satisfactorily with effective seals for disk harrow use. The first thought which frequently comes to mind as an advantage of these bearings is the possibility of reduced draft. However, careful experiments have shown that changing from hard-iron bearings to anti-friction bearings might reduce tractor power requirements a little, but only about 1 percent.

There is a saving in maintenance which can be achieved through the use of anti-friction bearings, however. The long-lasting, high precision of these bearings makes it more practical to develop a bearing-and-seal combination which will run for long periods without requiring attention.

Another major component which must be given careful consideration in disk harrow design is the implement hitch.

The hitch for direct-mounted offset disk harrows should provide a convenient means for changing the offset position of the disk with respect to the tractor. Provision for changing the relative cutting angles of the gangs makes it pos-

sible to obtain more even tillage, without imposing side draft on the tractor, over a wider range of conditions.

Since the weight of a direct-connected offset disk harrow tends to make the tractor less stable during transport, it is desirable to mount the harrow as close to the tractor as feasible. A longitudinal adjustment in the implement mounting hitch might be desirable, as the minimum distance between tractor and implement will vary with offset position.

Hitches for pull-behind offset disk harrows should have narrow tongues to permit short turns without catching the tongue with the tractor cleats or tire lugs. To facilitate operation in a diversity of conditions, both lateral adjustment of the hitch point (at the tractor drawbar) and vertical adjustment of the hitch mounting (at the harrow) should be provided. The hitch should be strong enough to withstand not only the forward pull in normal operation but also the forces that may be expected to result from any required turning or backing. Further the hitch should be of such a design that it will not collect trash.

Larger size harrows frequently are made up of two or more smaller sections. Connecting these sections with some sort of a flexible coupling permits the implement to follow the ground contour more closely.

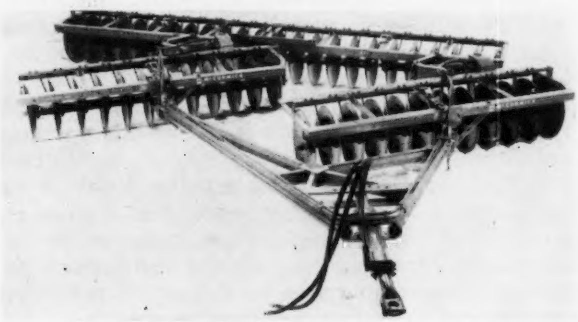

Fig. 4 Squadron offset disk harrow has front gangs divided with the rear gangs kept in line

Two general types of gang arrangements are used in these large harrows. One type is composed of two regular offset disk harrows which are coupled with either the front or rear gangs in line. An implement of this type is shown in Fig. 4. If the front gangs are connected in line, a relatively simple hitch can be used. Having the rear gangs separated, though, has the drawback of leaving a furrow in the center of each pass. Being in the center of the cut, this furrow cannot be filled during the succeeding pass. When the rear gangs are kept in line and the front gangs are separated, as illustrated, it is necessary to provide a rigid hitch between mountings on the two front gangs. This rigidity is necessary to present a straight pull on both sections and to ensure that the two sections will operate at the same cutting angle.

Another gang arrangement, shown in Fig. 5, has been offered recently for these larger, flexible harrows. In this style both the front and the rear gangs are kept in line, and a flexible joint is used in the middle of each gang. This setup has the advantage of permitting a simpler hitch and eliminates the deadfurrow in the center of the cut. The major problem with this type of harrow is maintaining even penetration from one end of a gang to the other.

As previously explained, the concave end of each gang tends to run deeper than the convex end. This tendency can be prevented by balancing the moment, M_l, of the front gang against the M_l of the rear gang. Building the linkage to transmit this moment from one gang to the other is made somewhat more difficult in this type of implement by the fact that this linkage must span a considerable distance when the gangs are in angled position and yet compress into a rather small space when the harrow is closed for transport.

Cost and Appearance Factors

Having determined the functional requirements which his new disk harrow design must meet, the engineer is then faced with the problems of cost and appearance. While these factors are generally of less importance than proper operation of the tool, they do play an important part in its over-all acceptability, and cannot be overlooked.

The cost of a particular type of construction will depend, to a large extent, on manufacturing methods. In turn, the methods used will depend on the rate at which the parts will be produced and on the particular organization and facilities with which the designer is working. The best solutions to this part of design work can be achieved through close cooperation between the engineering and manufacturing departments.

This is not to say, however, that the design itself is not a significant factor in the determination of costs. In general, the less expensive designs will usually be those which require less operations in their production. Normally it will follow from this that it is better to use designs which require fewer parts.

Simplicity is also frequently the keynote to good appearance. A design which involves a multitude of pieces stuck together is much less pleasing to the eye than one in which fewer parts are arranged so that they work and fit together with direct-flowing lines.

With regard to function, perhaps more can be learned about the action of disk blades and the effects and relative importance of the various factors which are involved in their operation. Undoubtedly there will be some improvements in cost and appearance resulting from the application of new materials and fabricating techniques, as well as from developing better ways to utilize materials and facilities which now are available. As a result, the farmer should be able to obtain an implement which is easier for him to operate and service.

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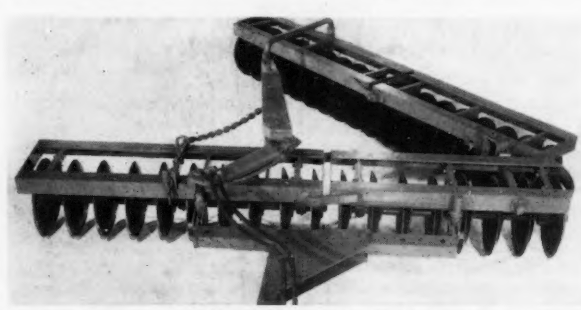

Fig. 5 A gang arrangement having both the front and rear kept in line and a flexible joint in the middle of each gang

Drainage Research Methods on Stony Soils

Herman Bouwer, Paul J. Zwerman, Harold E. Gray and Gilbert Levine
Assoc. Member ASAE · Assoc. Member ASAE · Member ASAE · Assoc. Member ASAE

A presentation of drainage research methods and techniques developed on the stony glacial till soils of central New York

IN THE past decade, drainage research theory has seen a rapid development, with which field drainage research has not been able to keep pace. Investigators trying to apply some of the new methods in the field are often faced with practical problems that were not encountered in laboratories or under the more or less ideal field conditions under which the practical applicability of some of the new developments was tested. The purpose of this paper is to present some of the experiences gained in drainage research work in the stony soils of central New York.

The soils in the area under study contain numerous rocks and boulders (mostly shale and limestone) at depths greater than 15 in; depth to bedrock usually exceeds 5 ft. The soil associations in this region are Honeoye-Lima and Lordstown-Volusia (1)*. Texturally, these soils range from loams to silt loams and silty clay loams. Occasionally small pockets of sand and gravel are found.

Subsurface drainage investigations generally involve one or more of the following measurements, depending on the purpose of the study:

- Measurement of phreatic surface elevations
- Measurement of groundwater pressures
- Measurement of soil permeability in situ.

In the following paragraphs, the techniques used in these measurements are discussed in more detail. Simplicity of operation, equipment, and materials were important factors in the selection or development of these techniques.

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The authors—HERMAN BOUWER, PAUL J. ZWERMAN, HAROLD E. GRAY and GILBERT LEVINE—are, respectively, associate agricultural engineer, Alabama Polytechnic Institute (formerly research assistant Cornell University), associate professor of agronomy, associate professor of agricultural engineering and assistant professor of agricultural engineering, Cornell University.

*Numbers in parentheses refer to the appended references.

Measurement of Phreatic Surface Elevations

The general practice of installing relatively shallow water-table observation wells down to about 5 ft with an ordinary soil auger is not suitable for stony soils. The presence of rocks makes it difficult to bore straight clean holes. Driving operations, however, proved to be satisfactory.

A solid octagonal steel rod with a hardened point and a diameter of 1½ in was driven into the soil with a fence post driver (Fig. 1). Just above the point, the rod was built up with a hard steel welding rod to locally increase the diameter by approximately ⅛ in. This reduced wall friction, so that less effort was required for the driving and removal of the rod. A second means to minimize wall friction was to turn the rod with a wrench a few times after every 20 to 30 blows and before removal. When the desired depth was reached, the rod was jacked out with a pinch bar, pivoting on a block placed behind the rod (Fig. 1). A perforated iron pipe or an open-seam sheet metal pipe was placed in the hole and closed at the top with a rubber stopper. Approximately 10 min were required for a crew of two men to install a well with a depth of 4 to 5 ft.

For the measurements of the water-surface elevations in the wells, a blow pipe (2) was successfully used. A ¼-in brass tube with depth markings was lowered into the well while air was blown continuously through it. At the instant bubbling was observed, the depth to water was read from the scale on the blow tube.

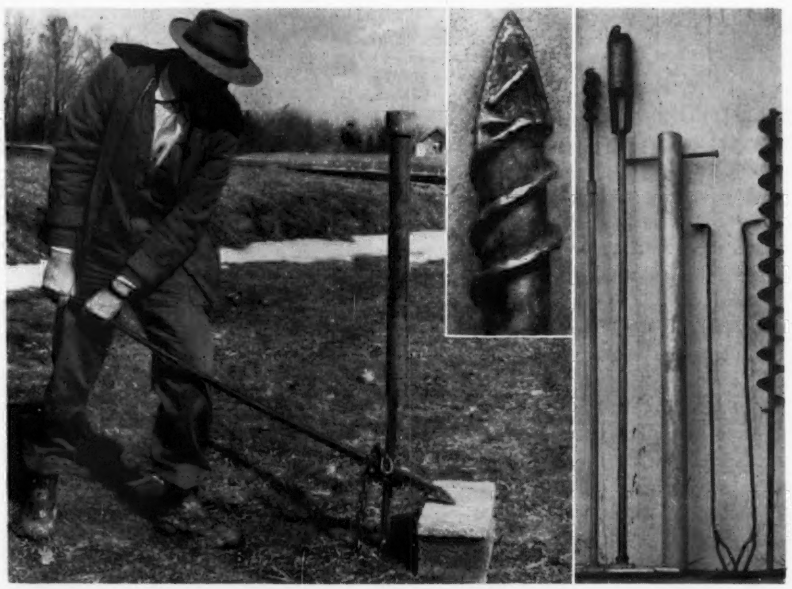

Fig. 1 *(Left)* In stony soils a steel rod can be driven into the ground to form a water-table observation well. A chain and pinch bar are used for removing the rod. The chain is wound twice around the rod and hooked. A firm grip can be exerted on the rod if the pinch bar is stuck through the lower chain loop. A post driver cap is shown on the rod • Fig. 2 *(Inset)* The point of the 4-in tractor-mounted auger used for drilling holes for field permeability measurements. The ridges and tip are built up with hard steel welding rod • Fig. 3 *(Right)* Tools used in cleaning out auger holes: *(left to right)* an ordinary soil auger, a soil auger to remove loose, dry dirt from the bottom of the hole, a bailer, a spoon and a hook to remove rocks from the holes, and an auger to remove puddled soil too plastic to be removed with the bailer

Measurement of Groundwater Pressures

Groundwater pressures, important in groundwater movement studies, are

measured with piezometers. Flushing and hand-drilling techniques, which are successfully applied in several parts of the country, are unsatisfactory on soils with many stones and rocks. Instead, the method whereby a pipe, closed at the bottom with a loose rivet or bolt, is driven into the soil and a small cavity below the pipe is formed by punching out the rivet or bolt when the pipe has reached the desired depth (2), could be used under these soil conditions. Pipes with ⅜-in diameter were driven into the soil with a post driver or a maul. The top of the pipe was protected by a cap during this operation. With this method, two men could install a 5-ft-depth piezometer in about 8 min. The depth to water in these piezometers again was read with the blow tube.

Only small diameter piezometer pipes can be installed with this method. When too large rocks obstruct the way of the pipe during the driving, pipe failure or crookedness usually results, and a new site has to be selected. For this reason, it is not recommended to use sets of piezometers under these conditions, if only phreatic surface measurements are to be taken.

Measurements of Soil Permeability in Situ

At the present time, two practical methods are available to measure soil permeability in situ below the water table: the piezometer method (5) and the auger-hole method (3, 4, 6). The latter was found to be the most suitable method for stony soils for the following reasons:

- It was difficult to control the size of the cavity below the piezometer pipe.
- Leakage between the soil and the wall of the piezometer pipe was sometimes present.
- The size of the "soil sample" involved with the piezometer method is small, so that only local permeabilities can be obtained. The presence of big rocks close to the cavity has a disturbing influence on the results.
- The auger-hole method not only gives a fairly representative permeability of the soil between the water table and a depth of roughly a foot below the bottom of the hole, but also makes it possible to obtain information of the variation of the permeability with respect to depth by taking measurements at different positions of the water table. To get similar information with piezometers, several piezometers with different depths would have to be installed. Although such a set of piezometers would give more accurate information as to the permeability of the individual layers in the soil profile, precise information of this nature will usually not be required other than for descriptive purposes. This is true partly because of the lack of practical means of handling or interpreting such data, and partly because of the local variability and complexity of soil permeability.
- For the auger-hole method, expressions and diagrams for evaluating the permeability from the field observations have been presented (3), which are suitable for large-scale application.

Auger holes for field permeability measurements were installed with a 4-in auger (Fig. 2) mounted on a tractor. The weight of the auger and the downward force by the hydraulic system of the tractor were not sufficient if the auger had to grind its way through rocks. In this case, two or three persons stood on top of the auger to obtain satisfactory drilling speed. Due to the grinding, the ridges near the point of the auger and the point itself wore off quickly. It was important that the ridges and the point be built up whenever necessary, if sufficient drilling speed were to be maintained. For conditions in the Honeoye-Lima association, the ridges of the auger had to be reconditioned with a hard steel welding rod after every 10 to 20 holes. With the auger in good condition, the average time required to drill a 4-ft-deep hole was about 10 min.

After the hole was drilled, its bottom was cleaned out with a special type of hand auger (Fig. 3). Most holes were drilled in the winter when the soil was still dry. When water started to collect in the holes in early spring, some caving of the walls occurred. After the holes had been cleaned out once or twice, however, the walls caved no more and the water in the holes remained clear. The holes then stayed intact for several months, no matter how often they were pumped out for permeability measurements. Fig. 3 shows the tools used in removing puddled and caved soils from the holes.

For the permeability determinations, the holes were pumped out with a bailer, consisting of a bilge flapper fastened at the bottom of a 3-in aluminum pipe. This is an effective way of removing water, as compared to a pitcher pump, since gravel and soil cause no trouble. The rate of water-surface rise in the hole was measured with an electric probe, which could be raised known distances. With this technique, 2 men could in one day read 50 holes uniformly distributed over a 15-acre field. Knowing the hole diameter, the original depth of the water in the hole, the rate of rise of the water surface, and the depth of the water in the hole at the time this rate of rise is measured, the permeability can rapidly be determined with Ernst's formulas or diagrams (3).

Although Ernst states that the maximum error in the permeability is 5 percent when evaluated from his diagrams and 20 percent when calculated with his formulas, too high an accuracy should not be expected with the auger-hole method. The accuracy of the determination of the permeability depends among other things upon the accuracy with which the hole diameter can be measured. Caving, however, usually results in irregularly shaped walls, so that it is difficult to arrive at an exact value for the hole diameter. Furthermore, inaccuracies are introduced with the evaluation of the depth of the impermeable layer, which must be known in processing the data obtained in the field.

Summary

Techniques are presented for measuring water-table elevations and groundwater pressures in stony soils. The selection of the auger-hole method as a suitable method for measuring soil permeability in situ for these soil conditions has been discussed, and the technique for installing auger holes and for obtaining and processing the necessary field observations presented.

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Plow-Planting of Corn

R. B. Musgrave, P. J. Zwerman and S. R. Aldrich
Assoc. Member ASAE

A SEEDBED is usually prepared for corn by first plowing the field with a moldboard plow After the field has been plowed it is customary to harrow a number of times either with a spike-tooth, spring-tooth, or disk harrow. Planting is then carried out as a separate operation after harrowing. This method of seedbed preparation and planting may be regarded as the conventional method.

It has been demonstrated by a number of agronomists (1, 2)* that corn yields are not reduced by planting directly on the furrow slice. In this method a conventional corn planter is operated over the field without additional seedbed preparation. Sometimes planting is carried out in the tractor wheel marks. This method may be regarded as a method of minimum seedbed preparation.

The purpose of this paper is to present information about a third method of preparing a seedbed for corn. This method will be referred to as plow-plant. It differs from both the conventional method and the minimum seedbed preparation method in that the two operations of plowing and planting are carried out simultaneously with plowing as the only tillage traffic on the field. The usual way to accomplish such experimental plow-planting is by trailing a conventional corn planter behind the plow. Preliminary trials at Cornell during 1951 to 1953 inclusive indicated the soundness of the trailing planter technique for the stony, poorly drained soils of central New York.

New Experimental Equipment

The experimental nature of this equipment should be emphasized. It is not intended as a commercially acceptable design. To perform satisfactorily as a commercial product under a wide range of field conditions and on a variety of plows, redesign would be necessary.

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The authors — R. B. MUSGRAVE, P. J. ZWERMAN and S. R. ALDRICH—are, respectively, professor of field crops, associate professor of soil conservation, and professor of field crops, department of agronomy, Cornell University. The work reported in this paper was carried out under Bankhead Jones Project No. 38 and No. 84.

*Numbers in parentheses refer to the appended references.

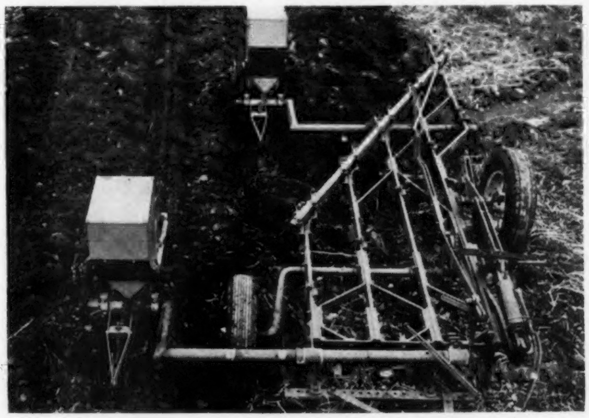

Fig. 1 Planting units mounted on a 5-bottom 14-in plow

Substantial savings in tillage operations possible by plow-planting corn as compared with conventional seedbed preparation

During the 1954 field season improved experimental equipment was developed for carrying out the plow-plant operations. This equipment is adapted for use on either a 3-bottom, 14-in plow as one-row equipment or on a 5-bottom, 14-in plow as two-row equipment.

A general view of the five-bottom plow and attached planting units is shown in Fig. 1. These units are commercially available as tool-bar planting units with fertilizer hoppers. The details of construction of the tool bar and the planting shoe or furrow opener are shown in Fig. 2. The planting shoe carries a depth skid. The supports in which the tool bar operates are also shown in Fig. 2. The length of the longer portion of the tool bar is 55 in; the crank is 20 in in length. Both are constructed of 2½-in inside diameter, heavy-walled, black pipe. The square bar for mounting the planting units was made by welding together 2 x ⅜-in angles. The bevel was slightly ground before welding. The supports shown in Fig. 3 were constructed from 3-in standard weight pipe.

Operation

In the case of the single mount on the 14-in, 3-bottom plow, row spacing will be 42 in with the corn row in the middle of the last furrow of the three furrows just previously turned. Thirty-five-inch row spacing results from a double mount on the 14-in 5-bottom plow. In the case of both mounts the tool bar is linked to the plow axles. When the plow is raised, the planting unit has ample ground clearance because the tool bar is both rotated and lifted. As the plow is lowered, the planting unit cuts into the plowed furrows.

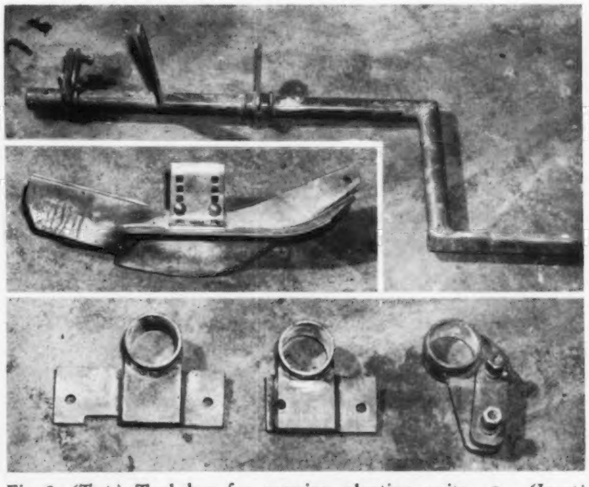

Fig. 2 *(Top)* Tool bar for carrying planting units • *(Inset)* Planting shoe with depth skid • *(Bottom)* Tool-bar supports

Fig. 3 First cultivation of plow-plant corn with soil packer and weeder

It should be pointed out that the planting unit rotates during the planting operation. Thus position of the tool bar on the plow in the ground, together with its rotation and a depth skid, effectively control the depth of planting. The fact that the plow is unbalanced in the raised position has not been a serious handicap with this experimental model. However, it should again be stated that such a condition would not be desirable in a commercial product.

The depth skid on the planting shoe serves to prepare a local seedbed. It lightly compacts the soil around the corn kernel. It also smooths over minor breaks in the furrow slice. Thus, although the area between the corn rows may be very loose and open, the immediate area around the germinating plant is well prepared as a seedbed.

Subsequent tillage operations are greatly simplified. The first cultivation of the corn can be rapidly carried out with a soil packer or a soil packer-weeder combination (Fig. 3). Only one additional cultivation has been found necessary.

During the 1955 field season, approximately 100 acres of corn has been plow-planted with this new experimental equipment. These demonstrational plantings were carried out in 20 different locations scattered over the state. These demonstrations have permitted a limited field-scale evaluation of the equipment. It was found that the method works very well in those situations where a good job of plowing could be carried out. However, excessively dry, cloddy soils which produce poor furrow slices gave difficulty. Poorly inverted furrows sometimes caused clogging of the packer wheel with stone or clods. Conventional planting encounters these same difficulties.

Planting takes place in a freshly turned furrow slice. Stony soils and uneven ground offer no difficulties as long as a uniform furrow can be turned. A poor job of plowing cannot be corrected by carrying out the plow-plant operation.

Yield Results

No yields were taken in 1951 and 1952 because of the great stand differential in favor of plow-planting as compared to conventional seedbed preparation. Corn yield results for 1953-54 inclusive were 79 bu per acre for plow-planting and 74 bu per acre for conventional seedbed preparation and planting. These yields were not significantly different. Stands were again better in the plow-planting operation.

In order to obtain additional information on the influence of various amounts of loosening and excessive tillage upon the yield of corn, additional seedbed preparation studies were carried out during 1952-54 inclusive. In these trials all seedbeds were first plowed and then subjected to the kinds of seedbed preparations indicated in Table 1.

TABLE 1. CORN YIELDS AND SEEDBED PREPARATION

Seedbed preparation on plowed land	Corn silage yield*	Approximate cost per acre
Deep-slow-rototilling	9.8	$ 6.00
Twice over with disc harrow	9.3	4.00
Land leveling or smoothing with land leveler	9.0	2.00
Six times over with disc harrow	8.7	12.00

*Tons per acre at 75 percent moisture.

While the yields in Table 1 are not significantly different, they do confirm previous findings that excessive tillage is an unnecessary expense and may decrease yields.

Summary and Conclusions

1 Savings on tillage operations by plow-planting corn as compared to conventional seedbed preparation for corn may amount to $10 or $12 per acre (3).

2 On the basis of four years of observation, corn yields are not reduced. Stands are improved.

3 The following additional benefits need to be quantitatively evaluated: better weed control, lack of root pruning, improved soil aeration, increased infiltration, and decreased soil erosion.

4 The experimental equipment described here should be tested extensively and modified to meet a wide range of field operating conditions.

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Drainage Research on Stony Soils

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Efficiency of the Milking Operation

W. H. M. Morris and L. L. Boyd
Assoc. Member ASAE Member ASAE

Results of a field study designed to compare milking with different balances of men and machines, single and two-level milking-parlor layouts, and side-opening and chute or lane stalls

A FIELD study of the milking of cows, the logical sequel to a laboratory study (11)*, was made at the New York State College of Agriculture in 1952. Many previous studies have been made of the efficiency of the milking operation. Among these are case studies, such as that of Carter (3), and descriptive and time studies with proposed improved methods, such as those of Brown (1), Byers (2), Cleaver (4), Rorholm (14), Sturrock, (17) and Corstiaensen (5). The great popularity of one parlor type in Australia and New Zealand has made possible studies of the variables other than layout. These have been reported by the New Zealand Dairy Board (13) and Cullity (6), and have been well reviewed by Scott and Scott (15). The New York study was designed to compare milking with different balances of men and machines, single level and two level milking parlor layouts, side-opening and chute or lane stalls, and the laboratory results with those obtained in the field.

The first step in the study was the making of a survey of the milking parlors known to have been installed in the state and of a number of well-managed stanchion barns. Murphy's (12) findings on the layout of stanchion barns were accepted for the selection of a sample to eliminate comparisons with poorly laid out barns. It was impossible, however, to estimate the average level of efficiency on the farms selected. The data obtained from the survey were used to select farms to keep a directed record of details of the daily milking, and also on which to make a detailed time study. The directed records were placed on all the farms surveyed in randomly selected areas of the state. These areas were visited in random order. A stratified random sample (16) of farms was selected for the time study; there were eight groups of five farms, with alternates in case it was not possible to study any particular farm that had been selected.

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The authors—W. H. M. MORRIS and L. L. BOYD—are, respectively, former research assistant in agricultural engineering and associate professor of agricultural engineering, Cornell University.

*Numbers in parentheses refer to the appended bibliography.

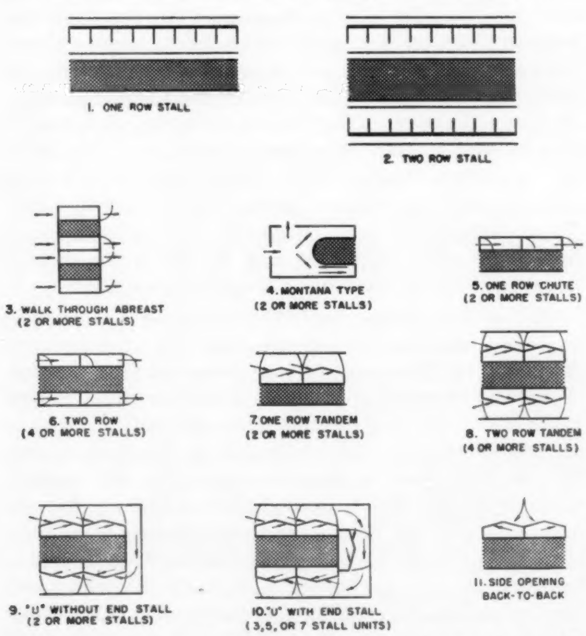

Fig. 1 Milking parlor arrangements included in the New York field study

THE DIRECTED RECORD

Seventy-seven usable directed records were collected, about 80 percent of those distributed. The variation in the man-minutes per cow and the cows milked per man-hour was much greater between the different balances of man and machines than between different layouts (Table 1). The milking operation in the stanchion barns included neither stanchioning the cows nor feeding the grain. As the number of machines handled by a man increased, the output per man-hour increased, but the number of cows milked per milking unit per hour decreased. This was found to be true throughout the field studies and will receive further comment.

TABLE 1. NUMBER OF COWS MILKED PER MAN-HOUR, FROM 77 DIRECTED RECORDS IN NEW YORK AND OHIO, 1952

Number of men	Number of units	Stanchion barn	Single level parlor	Chute parlor	In-line, side-opening parlor	All studies*
1	1					12.2
2	2	7.0	7.6			8.1
2	3	12.5				13.6
1	2	10.8	13.2		15.6	14.0
2	4					13.6
1	3	18.9		18.3		19.5

*The overall average includes studies in parlors other than those listed in this table.

TIME AND MOTION STUDIES

Procedure

Originally it was planned to obtain a sample of farmers who proposed to change their milking arrangements and to study the operation before and after the change. A preliminary study showed that this would represent the comparison of a poor layout of one type with a much better layout of another, and would yield little information to help a farmer to choose between the alternative "good" layouts. The idea was therefore dropped, although it may have possibilities.

After careful consideration it was decided not to attempt to rate the performance of each operator as had been done by French (7). The chief reasons were the subjective nature of rating, the anchorage effect (8) by which the rating

given to a performance depends somewhat upon the performance observed previously, and the impracticability of rating each element.

The time studies were made by two men, one using a stop watch and the other using a kymograph (9). The studies were made in random order within one area at a time, and the areas were visited in random order. This saved considerable travel, compared with making the studies throughout the whole state in random order. One evening and one morning milking were observed on each farm.

The Sample

The arrangements studied (Fig. 1) included five farms in each of the following groups:

- Stanchion barns and single-level parlors with bucket units
- Montana, walk-in—back-out, two-level parlors with pipe-line milkers
- Chute, walk-through parlors with pipe-line milkers
- Side opening, in-line parlors with pipe lines
- Side opening, in-line parlors with suspended bucket units
- Side opening, in-line parlors with regular bucket units
- Side opening, two-line parlors, some with and some without pipe lines
- Side opening, back-to-back parlors with into-can milking.

The sample included farms with herd size under 50, where the population available for study permitted, with the exception of the type 3† single-level abreast and the type 5 single-line chute parlors. The average herd size for each group was different (Table 2), but this had no effect on the recorded element times.

TABLE 2. AVERAGE HERD SIZE FOR THE FARMS SELECTED FOR TIME STUDY IN NEW YORK, 1952

Layout	Number of cows in herd
Stanchion barn	21.4
Single-level parlor	17.0
Montana parlor	18.9
Chute parlor	29.2
In-line, side-opening parlor	
with bucket milker	22.5
with pipe-line milker	27.2
Two-line, side-opening parlor	19.5
U parlor	46.5
Back-to-back parlor	20.0

Results and Discussion

Preparation. The preparation of the cow for milking should include certain elements. In addition, a quality factor undoubtedly exists. The time for the preparation (Table 3) showed two trends: *(a)* the time was reduced as the number of units handled per man increased from one to two or three and *(b)* in parlors with one unit for each stall, the preparation time was shorter than for similar man-machine balances with more than one stall per unit. The average time observed in the laboratory (0.31 min) was somewhat less than the times observed in the field with more than one unit for more than one stall. The field time in parlors with one unit for each stall was much less than the times observed in other parlors; this indicated that the preparation was not being adequately performed.

†Type numbers refer to numbered milking-parlor arrangements in Fig. 1.

TABLE 3. PREPARATION TIME FOR DIFFERENT MAN-MACHINE BALANCES FROM TIME STUDIES IN NEW YORK, 1952

Man-machine balance	Number of studies	Element time, min
1:1	4	0.74
2:2	20	0.52
2:3	4	0.58
1:2	22	0.43
2:4	7	0.34
1:3	8	0.44
2:6	4	0.34

Some operators have excellent routines for picking up a towel, dipping it in the bucket, picking up the strip cup, and traveling to the stall. On the other farms insufficient or poorly arranged equipment made a good routine impossible. For example, some had too few wash buckets; others had the bucket on the floor in elevated parlors and the worker had to stoop each time a towel was dipped.

Apply Unit. The time required to apply regular bucket and pipe-line units in the field was the same as that observed in the laboratory (Table 4). The time for the suspended bucket with surcingle was shorter in the field, owing to the difficulty of separating the time for application of the surcingle from that of other elements with which it is combined in the field. Both of the studies show that the element takes the same time in either single-level or two-level parlors.

TABLE 4. TIME TO APPLY DIFFERENT UNITS IN DIFFERENT LAYOUTS IN NEW YORK, 1952

	Time in minutes			
		In-line	Milking Laboratory	
Type of unit	Stanchion barn	side-opening parlor	Single-level	32-in elevation
Regular bucket	0.35	0.33	0.33	0.34
Suspended bucket	0.36	0.36*	0.47	0.32*
Regular pipe line		0.21		0.22

*Bucket suspended from a bracket or randel.

Adjust and Remove Unit. In the analysis no attempt was made to separate the time spent to adjust the unit, or to machine strip, from that to remove the unit, although it would have been possible in some instances. The combined time decreased with an increase in the number of units per man. On some farms idle time was disguised as machine stripping time, since the operator had nothing else to do. No difference was observed in the machine stripping and removal time between regular and suspended units. In 72 per cent of the operations observed some hand stripping was done, averaging in some instances as long as one minute a cow. The combined times in the laboratory study included a fixed time of 0.5 min to adjust the unit; for this reason they are not comparable with the times observed in the field.

Let in, Let out, and Feed. The time observed for letting in, letting out, and feeding the cows was varied greatly, depending on the number of cows let in at a time, the location of the controls for the let-in and let-out doors, the appetite of the cows, and on other factors that might be classed as "cow psychology". In the type 11 back-to-back parlors, the cows were more responsive to the call of the operator, probably because they were visible from the pit. On one farm cows that had been milked were actually pushed out of the parlor by the incoming cows. Greedy cows, as well as cows that get large amounts of grain, come in readily; cows on poor pasture also come into the parlor more readily. It is difficult for the operator to decide when to go into the yard for a cow that is slow to come into the parlor. If the cows

are not accustomed to coming in readily, time is saved by bringing them in groups, making use of the opportunity to "stack" the cows in the alleys of side-opening parlors. The times for these elements again show that the time per cow for variable elements such as these decreases with an increase in the number of units handled by the operators. The layout does not seem to be the determining factor in the time required to perform these elements (Table 5), except in the case of the back-to-back parlor which was mentioned earlier. This parlor also has the advantage of compactness, giving very short travel distances to change and feed the cows. In the chute parlor the time to change the cows was a little shorter than that for the side-opening or the Montana stalls; less time was spent for letting in, probably because several cows were let in at one time.

TABLE 5. TIME TO LET IN, LET OUT, AND FEED COWS IN DIFFERENT LAYOUTS IN NEW YORK, 1952

	Time per cow, in minutes			
	Element			
Parlor layout	Let in	Let out	Feed	Total
Single level	0.29	0.16	0.30	0.75
Montana				0.82
Chute	0.26	0.25	0.21	0.72
In line, side opening	0.41	0.27	0.15	0.83
Back to back				0.56

Caring for the milk. Caring for the milk included any work connected with getting the milk from the cows into the cans in the milkroom. Pouring the milk into cans in the milking area, although not permitted in many milksheds, took little more time than changing the cans with a pipe line filling single cans in parallel. Where the milk was carried in pails to the milkroom and strained, considerable time was taken, and where there was a great distance to the milkroom this became the limiting factor in the output. The sample was not sufficiently representative of the methods of caring for milk, since selection was made on the basis of layout. The time spent in caring for the milk, as recorded during the field studies, was that for summer when the production per cow is usually at its lowest; therefore, the results on a per-cow basis are not significant, since the time is a function of the production.

Number of operators. The results show quite clearly the depressing effect of a second man in the same area on the output per man in milking. Studies were made on five farms with both one-man and two-men milking. The average increase in the total output was one-third, as compared with double the labor force (Table 6). As the number of units per man decreased, the extra time was spent for longer preparation and machine stripping with an increase in delay time. In addition, the length of time the unit was on the cow was slightly reduced. A comparison between the different man-machine balances (Table 7) shows results similar to those from the directed records. The same trend has also been shown by workers in Australia and New Zealand (15). The results of the milking-parlor research at the University of Wisconsin (18) showed the same effect but to a much smaller extent, probably because the machine times observed in the laboratory are almost invariably shorter than those observed in the field studies.

TABLE 6. THE PERFORMANCE OF ONE MAN AND TWO MEN IN THE SAME PARLOR IN NEW YORK, 1952

	Man-to-machine balance	
	1 to 2	2 to 2
Cows milked per hour	15.80	21.00
Cows milked per man-hour	15.80	10.50
Man-minutes per cow	3.80	6.34
Delay time, man-minutes per cow	0.45	1.94
Adjust and remove unit man-minutes per cow	0.91	1.74
Machine time, minutes per cow	6.42	5.83
Output as percentage of 1 to 2	100	133

Comparison Between Layouts. It has already been shown that the balance of men and machines has a greater effect on the output per man than has the layout. In any comparison between layouts the balance must, therefore, be the same; if the number of units per man is limiting the output, no over-all differences between layouts can be apparent. This is true of one unit per men, and may be true of two units per man. The layouts have been compared on the basis of the balance in Table 7. To compare the differences in output caused by layout, the average output for each balance is given as a percentage of that for a balance of one man and two machines. Certain comparisons were made between parlors; these are given in detail in the complete report of the study (10). In general, the chute or lane parlor appears to be superior to the other types on the basis of output per man and low machine time per cow.

There was little difference between outputs in the layouts with one unit for each stall and those with one unit for more than one stall, although as stated before, the preparation was not always adequate in the former layout. In layouts with one unit for two stalls the cows were in the stalls for long enough to prevent the time required for the cow to eat the grain from limiting the output.

Side-opening stalls are more flexible than chute stalls, which is especially important if dry cows are to be run through the parlor. Slow-milking cows in the eight-stall chute parlors were observed to cause a delay in up to three or more of the succeeding cycles.

There was no difference in output in single-level parlors

TABLE 7. COMPARISON OF MILKING COWS WITH DIFFERENT MAN-MACHINE BALANCES IN NEW YORK, 1952

	Man-machine balance						
	1:1	2:2	2:3	1:2	2:4	1:3	2:6
Number of milkings observed	4*	15	4	33	9	10	4
Man-minutes per cow	3.52	5.79	5.17	3.43	3.69	2.24	3.37
Percentage of 1:2	103	169	151	100	108	65	98
Cows milked per man-hour	17.0	10.2	11.6	18.0	16.2	26.8	17.8
Percentage of 1:2	95	57	64	100	90	149	99
Cows milked per hour	17.0	20.4	23.2	18.0	32.4	26.8	35.6
Percentage of 1:2	95	113	129	100	180	149	198
Delay time in man-minutes	0.24	1.43	1.74	0.55	0.47	0.21	0.48
Pe-centage of 1:2	44	260	316	100	85	38	87
Adjust and remove unit, min	1.45	1.65	1.62	0.85	1.35	0.51	1.38
Percentage of 1:2	171	194	191	100	159	60	162
Machine time, minutes per cow	3.27	5.24	6.15	6.07	5.81	5.75	7.90
Percentage of 1:2	54	86	101	100	96	95	130

* These were all in the back-to-back parlor.

and two-level parlors; this was shown also by the laboratory results.

Criticism of Method. It has always been difficult to obtain an accurate comparison of milking in different layouts with different balances of men and machines. This method has partially overcome the difficulty. Much better comparisons could have been obtained had it been possible to select the sample from operations with each man handling two or more units. Had the number of layouts studied with one or one and a half units per man been replaced with parlors using three or four units a man, extra studies would not have been required, and the results would have given more conclusive comparisons of the different layouts. Such a sample did not exist in the state at the time the study was planned. A future study might well include stanchion barns with and without pipe lines, chute parlors, in-line and two-line side-opening parlors, and U-shaped parlors.

CONCLUSIONS

The results of the field studies correspond closely to the results of the laboratory study.

The most satisfactory layout for a milking parlor should be six stalls and three units, with three elevated stalls on each side of the work area. The output from such a layout may not be higher than from a similar number of stalls and units arranged in a single-level abreast layout, but much less effort will be required to operate the two-level parlor. The use of side-opening stalls makes the parlor more flexible, but it is not certain that the extra cost of these and the wider building to house them would result in a proportionately higher output from labor. In this layout the milk should be carried in a pipe line either into a bulk-cooling tank, or, where there is no bulk pickup, into a group of cans arranged to require a minimum of attention during milking. It should be pointed out that no study has been made of the pipe-line milking in stanchion barns. However, there is evidence to indicate that one man handling three units under similar conditions in a stanchion barn can milk at a comparable or greater rate, since the time to let in, let out, and feed the cows would not be included in the milking time. It is certain, however, that milking in the stanchion barn would require considerably more human effort.

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Moduli of Uniformity and Fineness of Ground Feed

TO THE EDITOR:

LAST September I received a copy of the "ASAE Recommendation: Modulus of Uniformity and Modulus of Fineness of Ground Feed." I understand this is an official Recommendation of the ASAE, and in view of this you may be interested in having the following comments based on the considerable amount of experience we have had with such determinations.

The technique of carrying out the determination is not described in the Recommendation, but it is referred to by several authors (*e.g.*, J. W. Martin and J. Roberts, "Feed Grinding with Small Electric Motors," Bulletin 87, Kansas State College, 1941) as though it is part of the proposed standard, namely, 250-g sample, oven-dried at 100 C to constant weight ro-tap sieved for 5 min. We do not use a ro-tap shaker, because we were at first unable to obtain one, but we do use a mechanical shaker of rather similar design. Our sieves are British standard, but for this purpose they can be regarded as a close approximation to Tyler, and we use the ASAE method of fineness modulus calculation. Our comments are as follows:

1 We look forward to the establishment of a standard sieving technique and method of modulus calculation.

2 Most of our work has been done with barley meal and, in this case at least, we definitely avoid drying the samples. The following table will, I think, make the reason clear:

FINENESS MODULUS OF BARLEY MEAL
(Moisture content, 14-15 percent)

Meal	Condition	Fineness modulus				Mean
A	As milled (undried)	1.81	1.82	1.89	1.86	1.85
A	As milled (undried)*	1.87	1.90	1.88	1.96	1.90
A	Dried at 100 C	1.93	2.05	1.98	2.10	2.02
B	As milled (undried)	1.40	1.41	1.49	1.44	1.44
B	Air dried	1.42†	1.48†	1.48	1.41	1.45

*Sieved after 6 months storage in airtight bottle.

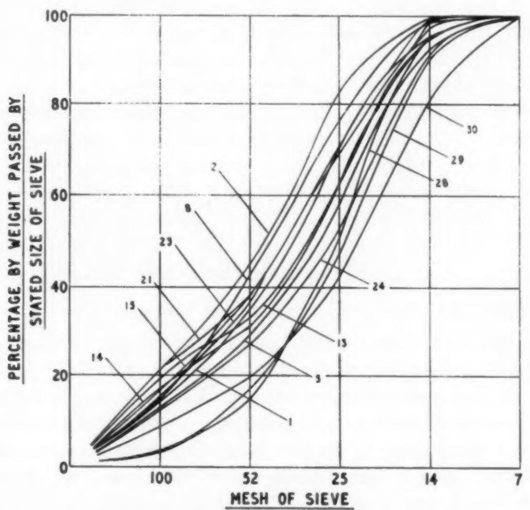
†Mean of three replicate determinations.

These results are part of some work carried out, first, to determine whether any sort of drying was necessary, and, secondly, to see whether it was important to sieve samples immediately after grinding.

For our work we are fairly satisfied that the answer to both these questions is in the negative, and indeed drying seems if anything to cement aggregates and cause a slight increase in fineness modulus.

3 We sieve for 5 min, as indicated in the ASAE Recommendation, but we have reduced the size of sample to 100 g because we consider that the 1-lb sample (or 250 g) is on the large side for 6-in sieves, particularly when fine meals are involved. This change is, however, a matter of expediency for our particular application, and a 1-lb sample is probably satisfactory for coarser meals where the influence of sieve blinding is negligible.

4 Finally, a comment on the Modulus of Uniformity. The fineness modulus certainly does not completely characterize a meal, but when we require more information we cannot see the utility of only going halfway as the uniformity modulus does. One might as well use all the information available and disregard the arbitrary fine-medium-coarse subdivision, and present the results as a distribution histogram, or better still cumulative frequency curves. (The accompanying set of such curves showing a sieve analysis of barley meal may be of interest.)



A set of cumulative frequency curves showing a sieve analysis of barley meal

We are interested in comparing on an absolute basis the fineness figures obtained in an ASAE test and one using our own setup. The only straightforward way of doing this would be for us to take a fine and a coarse meal and carry out a number of replication determinations and then send the remainder of the sample to some organization in the USA who could also determine the fineness modulus. Perhaps you could suggest the name of one of the experiment stations that might like to help in this way.

PETER HEBBLETHWAITE

National Institute of Agricultural Engineering
Wrest Park, Silsoe, Bedfordshire, England

(EDITOR'S NOTE: If any experiment station agricultural engineer is interested in cooperating with Mr. Hebblethwaite as suggested in the last paragraph of his letter, it is suggested that he correspond with him direct at the above address.)

Ghaly Method of Topographic Surveys

TO THE EDITOR:

I WISH to call to your attention a few points which were not included in the article, entitled "The Ghaly Method of Topographic Surveys" by Howard Keck, my intimate friend and colleague at the University of California, and prepared by him from my original paper and drawings sent to you and published on page 26 of AGRICULTURAL ENGINEERING for January 1955. I would appreciate having these points covered in an early issue of your publication.

1 The method is very flexible in that the sighter, *B*, can take any convenient position in the neighborhood of the instrument man, *A*. There are any number of positions which can be conveniently occupied by *B*, in order to get a better distribution of sight lines relative to the *A* position.

2 For a large area several groups of *A*, *B*, and rodmen can easily work together to cover the whole area quickly.

3 The method can be reversed and any points on the map can be located on the ground. To facilitate this reversed procedure, the positions previously occupied by *A* and *B* need to have been marked on the ground. The reversed procedure can be conducted quicker by adopting a system of signals among the surveying party members. It is understood that a good engineer or surveyor can arbitrarily decide on a system of signals to direct the movements of the rodman based on the logic of plane geometry. (N.B. This facilitated reversed procedure is independent of the scale of the map in use.)

4 I invented the Ghaly method of topographic surveys and have used it successfully in Iraq, not in Iran, as stated in Mr. Keck's article.

AZMY WASSIF GHALY

4 Azer Habashi St.,
Ghamrah, Cairo, Egypt

A Correction

ON ACCOUNT of an error in editing the article, entitled "Drawbar Dynamometer Using Strain Gages" in AGRICULTURAL ENGINEERING for August, the second paragraph beginning on page 522 is corrected to read as follows:

"It is interesting to note that . . . the battery current in HI range is computed as 38 ma (milliamperes). Measurement shows it to be actually 37½ to 38 ma in HI range. In LO range it is 70 ma."

Instrumentation

THE impact of instrumentation is extremely wide, affecting not only science and engineering but also manufacturing, commerce, and government activities. Measurement is so important to the progress of science that all scientists sooner or later become involved in some phase of an instrument problem. With the increased range and complexity of science, the limit as to what can be observed or studied is frequently set by the characteristics of available instruments. The trend towards measuring more minute effects, or observing events occurring in shorter times, or studying phenomena very remote from our ordinary senses of perception, places an extreme demand on the instrumentation process, frequently requiring an elaborate chain of transducers, amplifiers, differentiators, integrators or counters.

Effect of Atomization on Airplane Spray Patterns

D. A. Isler and D. G. Thornton
Member ASAE

As SOON as airplane spraying came into common use, it was recognized that atomization of the spray was an important factor in effectiveness of the application. The degree of atomization influences the distribution of the spray, as well as its loss due to evaporation, drift, and convection. There has been little investigative work done to determine the most efficient atomization of sprays for airplane application.

This paper discusses a study* made to determine, for forest insect control, the atomization which gives the widest and most uniform swath without excessive losses in total spray deposit. This is an important point, because it is essential that spraying costs be held to a minimum, due to the comparatively low annual return per acre from forest areas. Even small improvements in uniformity of spray distribution or width of effective swath would result in considerable saving when applied to large control operations. It should be pointed out that forest spraying differs from crop spraying in that the minimum safe height of flight over forest areas is 50 ft above the tree tops, and that the results reported herein apply only to flights made at this height.

A study of airplane spraying has been made to determine the degree of atomization which produces the most efficient spray pattern

Equipment and Procedures

The flight tests comparing the effects of three degrees of atomization on spray deposit patterns consisted of two series. In one, the effect of a coarse spray, 300 microns mmd (mass median diameter), was compared with that of a medium spray, 150 microns mmd. In the other, the medium spray was compared with a fine spray, 80 microns mmd.

All tests were made with a Stearman airplane (220-hp engine) equipped with dual sprayer apparatus (2)† consisting of two independent spray systems, so that in a single flight two different atomizations were released simultaneously under identical meteorological conditions.

The coarse atomization was obtained by using centrifugal-type hollow-cone spray nozzles with the 1/8-in-diam orifices directed to the rear (opposite to direction of flight), and a spray pressure of 25 psi. The medium atomization was produced with the same nozzles and spray pressure by directing the orifices forward into the airstream and down about 12 deg. The fine atomization was obtained by using a spray pressure of 100 psi and flat spray nozzles‡ with the orifices directed forward into the airstream and down about 20 deg.

For all tests the nozzles were spaced along full-span booms so that 60 percent of them were in the outboard one-half of the boom and the remainder in the inboard one-half as shown in Fig. 1. Atomization was determined by the photographic method described by Davis (1). The equipment was adjusted to deliver spray from both systems at the rate of 21 to 22 gpm, approximately 1 gpa (gal per acre) over a 132-ft swath at 80 mph.

The spray mixture used was an oil solution containing 1 lb of DDT per gal. A measured quantity of a blue dye tracer was added to spray in one of the systems of the dual sprayer and either an orange or red dye was added to the spray in the other system. In each test the plane made a single-swath upwind flight over open ground at an altitude of 50 ft. Temperature, wind direction and speed at 50 ft and 5 ft, and relative humidity at ground level were recorded for each flight.

Spray distribution across the swath was determined from spray samples collected on each of two 6 x 6-in aluminum plates located at 5-ft intervals on a line at right angles to the line of flight. For the first series, comparing coarse atomization with medium, four parallel sample lines were used for each test. The spray distribution along the four lines of any one flight was quite similar; therefore, only one sample line was used in the second series. The quantity of spray deposited from each spray system, at each sample point, was determined by measuring, with a spectrophotometer, the amount of each dye tracer in the deposit sample.

Results

The effects of the atomizations on spray distribution, maximum deposit, and percent of spray recovered were compared. To show spray distribution across the swath, deposit in gpa was plotted against distance on a line at right angles to the flight line. Curves were drawn for each atomization and each sample line. Swath width, or the distance in feet over which the spray deposit was not less than a specified amount, was measured from each curve. The peak, or maximum, deposit in gpa at any one sampling point along each line was recorded. The percent of spray recovered was calculated by the formula: (quantity of spray deposited ÷ quantity of spray released) x 100 = percent recovery.

Each of the above types of data was subjected to the

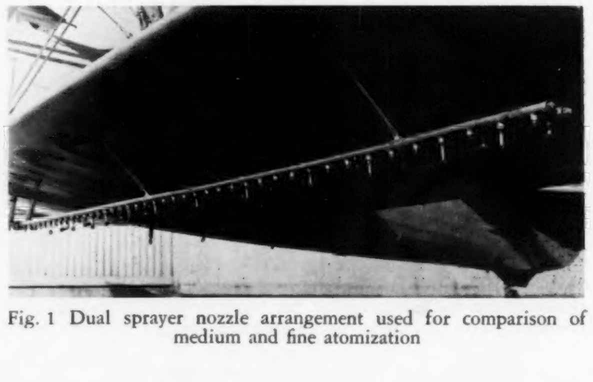


Fig. 1 Dual sprayer nozzle arrangement used for comparison of medium and fine atomization

Paper prepared expressly for AGRICULTURAL ENGINEERING.

The authors—D. A. ISLER and D. G. THORNTON—are, respectively, senior agricultural engineer, farm machinery section, agricultural engineering research branch (ARS), and entomologist, division of forest insect research (FS), U.S. Department of Agriculture.

*Conducted cooperatively by the Agricultural Research Service and the Forest Service, USDA.

†Numbers in parentheses refer to the appended references.

‡Spraying Systems Co. Tee Jet 8004; Accessories Mfg. Co. Sprajet 80.4; Delevan Mfg. Co. AG8, or equivalent.

TABLE 1. SWATH WIDTH IN FEET AT VARIOUS DEPOSIT LEVELS FROM FIVE FLIGHTS COMPARING COARSE WITH MEDIUM ATOMIZATION

Deposit, gpa	Swath width in feet* Coarse atomization	Medium atomization	Difference	Significance of difference
0.1	137	166	29	HS†
0.2	114	135	21	S‡
0.3	102	114	12	NS§
0.4	90	97	7	NS
0.5	81	80	1	NS
0.6	70	66	4	NS
0.7	61	53	8	NS
0.8	51	42	9	S
0.9	43	28	15	S
1.0	36	19	17	S

*Distance over which deposit rate was not less than that given at left.

†Highly significant (99 percent probability level).

‡Significant (95 percent probability level).

§Not significant.

TABLE 2. SWATH WIDTH IN FEET AT VARIOUS DEPOSIT LEVELS FROM SEVEN FLIGHTS COMPARING MEDIUM WITH FINE ATOMIZATION.

Deposit, gpa	Swath width in feet Medium atomization	Fine atomization	Difference	Significance of difference
0.1	175	198	23	S
0.2	139	132	7	NS
0.3	115	103	12	NS
0.4	90	72	18	S
0.5	69	48	21	S
0.6	53	31	22	HS
0.7	41	17	24	HS
0.8	32	8	24	S
0.9	22	5	17	S
1.0	14	3	11	S

analysis of variance appropriate for a randomized block design, which permitted variation caused by flight difference to be separated from ordinary sampling variation.

Coarse Atomization vs. Medium Atomization

Five test flights were made in this series. Based on the average from all flights Table 1 shows the swath width at various deposit levels. The medium atomization produced a wider swath than did the coarse one at deposit levels of 0.1 and 0.2 gpa, and the difference was statistically significant. There was no significant difference between the two at deposit levels of 0.3 to 0.7 gpa. The coarse atomization produced a significantly wider swath than the medium at deposit levels of 0.8, 0.9, and 1.0 gpa.

The maximum deposit averaged 2.4 gpa from the coarse spray and 1.5 gpa from the medium spray and the difference was highly significant. Seventy-four percent of the coarse spray and 73 percent of the medium was recovered. The difference was not significant.

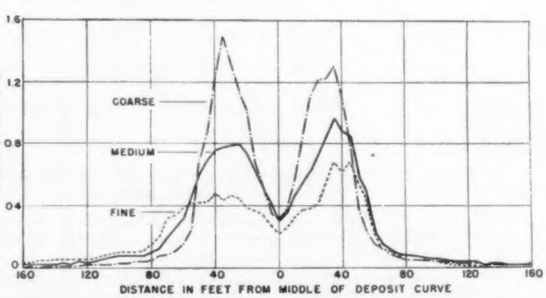


Fig. 2 Average spray deposit from three degrees of atomization

Medium Atomization vs. Fine Atomization

Seven test flights were made in this series. Based on the average from all flights Table 2 shows the swath width at various deposit levels. It will be noted that a significantly wider swath was obtained at the 0.1 gpa level from the fine than from the medium atomization. There was no significant difference at the 0.2 and 0.3 gpa levels. At deposit levels of 0.4 gpa or more the swath was significantly wider from the medium than from the fine atomization.

The maximum deposit averaged 1.2 gpa from the medium atomization and 0.9 from the fine and the difference was significant. An average of only 60.1 percent of the fine spray was recovered on the ground while 70.9 percent of the medium was recovered. This difference was highly significant.

Discussion

With the dual sprayer it was possible to compare only two degrees of atomization in any one flight and the data presented above are the results of two series of paired tests. A visual comparison of the three degrees of atomization is shown by the spray deposit curves in Fig. 2. The latter were prepared by selecting from each series the three flights which were least influenced by crosswind effects. The curves represent the average of the data from three coarse atomization tests (first series), three fine atomization tests (second series), and six medium atomization tests (both series).

The most uniform distribution of the spray across the swath was obtained with the fine atomization and the least uniform distribution with the coarse atomization. The latter produced the highest deposit peaks and the former the lowest. The steep curve of the coarse atomization shows that this type of spray fell more vertically and with less lateral spread than the sprays from either of the other atomizations. These maximum peaks of deposit represent inefficient spray distribution because, in general, they are considerably greater than necessary for effective control of forest defoliators.

Low rates of spray deposit in the centers of the swaths were caused to a considerable extent by the particular spanwise nozzle arrangement used (see equipment and procedures section), which was essentially the same for all flight tests. Later tests have shown that the deposit in the center of the swath can be increased by moving a greater percentage of the nozzles inboard.

The percentage of spray recovered on the ground was highest from the coarse spray and lowest from the fine spray. The latter was more subject to losses caused by drift, convection, and evaporation.

Coarse atomization is undesirable because of the narrow swath and high peaks of spray deposit it produces. Even though the fine atomization produced a somewhat more uniform distribution than the medium, it is also undesirable because of the greater loss of spray.

Summary

A comparison is made of the effects of three degrees of atomization (300, 150, and 80 microns mmd) on deposit patterns of sprays released from a Stearman airplane flown at 50 ft above the ground.

The results show that under the conditions of these upwind tests, the coarse atomization resulted in the narrowest swath, least uniform distribution across the swath, and exces-

(Continued on page 604)

Some Effects of Oversizing Rear Tractor Tires

I. F. Reed
Member ASAE

A performance study on three probable methods of oversizing rear tractor tires

THOUGH manufacturers of tractors attempt to equip their units with rear tires of the size deemed effective and economical for most field conditions, operators encounter soil conditions or conditions of loading where oversize tires improve performance. The term "oversize" refers to any tire larger than the one normally furnished.

There are two methods of oversizing tractor tires using available stock sizes. The most commonly practiced is to use the same rims and obtain the oversizing by increasing the cross section of the tire. Thus, as shown in Fig. 1, 12-38 or 13-38 tires may be used in place of the 11-38 size. Though the same wheel and rim may be used, both the tire cross section and over-all diameter are increased. This raises the axle of the tractor, makes it necessary to have increase in clearance for mounted tools, and changes the effective speeds of the tractor for all gears.

Realizing that tractor operators were putting oversize tires on the tractors in spite of these handicaps, representatives of companies manufacturing tractors and those manufacturing tires instigated a study through the SAE tire test subcommittee, which is made up of representatives of each group, to determine the effects of two methods of oversizing tires that give increased cross section without increasing the over-all diameter or raising the axle. One method shown in Fig. 2 uses available tire sizes by decreasing the rim size as the tire section is increased. Thus a 12-38 tire may be replaced by a 13-36 or a 14-34. This requires that the rim and, under present conditions, the tractor wheel must be replaced to mount the tires

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Urbana, Ill., June, 1955, on a program arranged by the Power and Machinery Division.

The author—I. F. Reed—is senior agricultural engineer, tillage machinery laboratory section, agricultural engineering research branch, U.S. Department of Agriculture, Auburn, Ala.

Acknowledgment: The author appreciates the assistance and advice of representatives of companies manufacturing tires and companies manufacturing tractors who cooperated in this study so effectively through the SAE Tractor Tire Committee.

TABLE 1. SOIL CONDITIONS FOR TESTS IN FIG. 4

Soil Range, in	Lakeland sand Percent moisture	Hiwassee fine sandy loam Percent moisture	Lloyd clay Percent moisture	Lloyd clay Volume weights
0 - 2½	2.4	3.4	17.2	0.90
2½ - 5	2.8	4.6	21.0	1.12
5 - 7½	3.7	5.8	21.1	1.08

No volume weights were taken for the Lakeland and Hiwassee soils. They were in a very loose condition as left by the cross tiller. The Lloyd soil was subsurface packed.

TABLE 2. MEASUREMENTS AND SPECIFICATIONS FOR TIRES USED FOR TESTS IN FIG. 4 (LOAD FOR ALL TIRES, 2,570 LB. INFLATION, 12 PSI)

Tire	Rolling radius Lakeland sand Ft	Rolling radius Hiwassee sandy loam Ft	Rolling radius Lloyd Clay Ft	Water for 85% fill Lb	No. of lugs	Rated load at 12 psi inflation Lb
12-38	2,431	2.444	2.430	500	24	2570
13-36	2.433	2.459	2.446	566	23	2965
14-34	2.463	2.480	2.462	655	22	3540
38-13	2.454	2.454	2.437	528	24	2970
38-14	2.472	2.493	2.478	595	24	3530

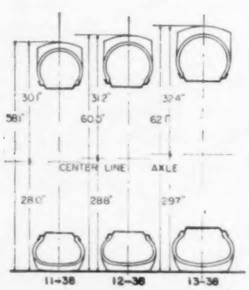


Fig. 1

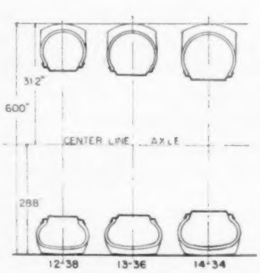


Fig. 2

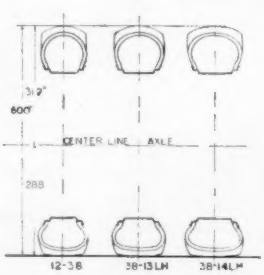


Fig. 3

Fig. 1 Diagram showing relative axle height and tire diameters when oversizing 11-38 rear tractor tires to 12-38 and 13-38 sizes using the same rims and regular production tires • Fig. 2 Constant axle height and over-all diameter are maintained when rear tractor tires are oversized by decreasing the rim diameter as the cross section is increased • Fig. 3 Constant axle height, rim diameter, and over-all diameter are maintained when 12-38 rear tractor tires are oversized by tires 13 and 14 in wide, but have the same section height as the 12-in tire

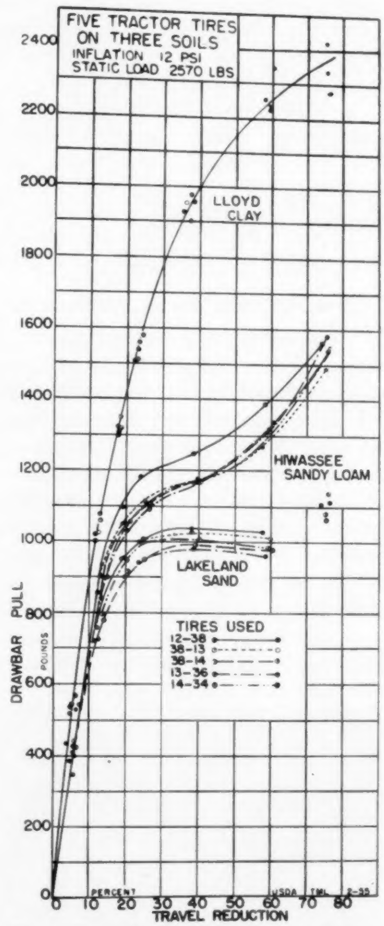
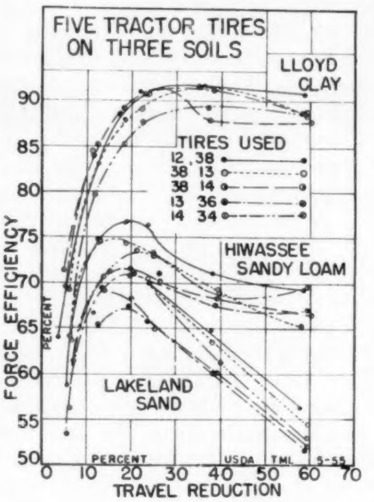


Fig. 4 Data showing relationship between drawbar pull and travel reduction in three soils for rear tractor tires oversized by the methods shown in Figs. 2 and 3, that is, methods which keep the axle height and over-all diameter the same



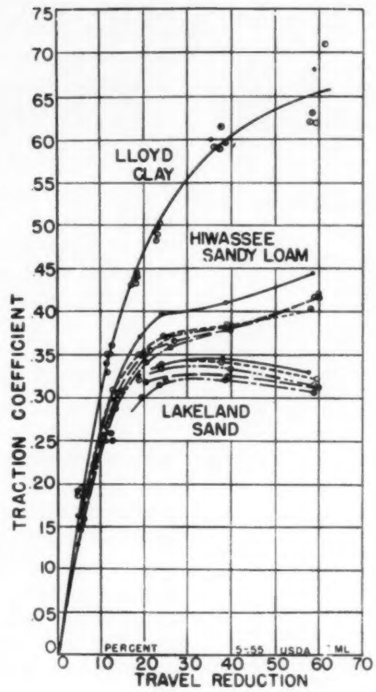


Fig. 5 Curves show the relationship between travel reduction and force efficiency for the tests shown in Fig. 4

Fig. 6 *(Right)* Traction coefficients for the tests shown in Fig. 4

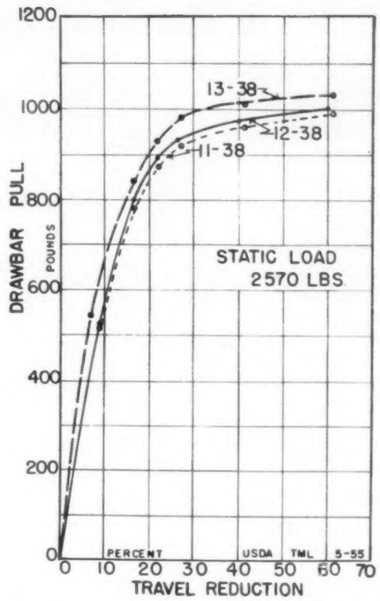


Fig. 7 Data showing relationship between drawbar pull and travel reduction in Lakeland sand for rear tractor tires oversized by the methods shown in Fig. 1 and carrying a 2,570-lb static load

with the larger sections. This makes the change expensive.

A third method of oversizing shown in Fig. 3 requires the development of tires planned especially for oversizing. In this arrangement the oversize tire has the same height of section and over-all diameter as the base size tire and uses the same size rim and wheel. The tires used in this study were designed as oversizes for 12-38 tires. The heights of section for the tires 13 and 14 in wide are the same as that for the tire 12 in wide. As a matter of designation, the rim diameter is given first and the letters LH added to distinguish this particular group of tires that have the same section height as the 12-38 tire. Thus we have the 38-13LH for the 13-in tire and 38-14LH for the tire that is 14 in wide. The top of the inflated section tends to be oval instead of round. Since, as can be seen in Fig. 3, the axle height and over-all diameters remain the same, the tractor gear ratios are not affected by the oversize tire; thus they do not introduce additional problems when using mounted implements. However, this method of oversizing requires the development of special tires which, due to the special construction necessary to maintain the required shape, may cost more. The question then is, are the three methods of oversizing equally effective in handling loads under adverse conditions or is

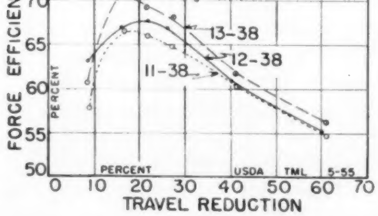


Fig. 8 Force efficiencies for the tire tests shown in Fig. 7

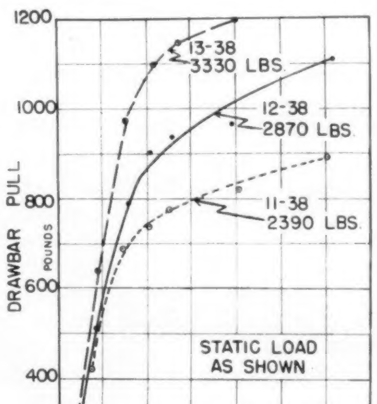


Fig. 10 Data showing relationship between drawbar pull and travel reduction in Lakeland sand for the same three tires shown in Fig. 7 but each loaded to its maximum recommended load

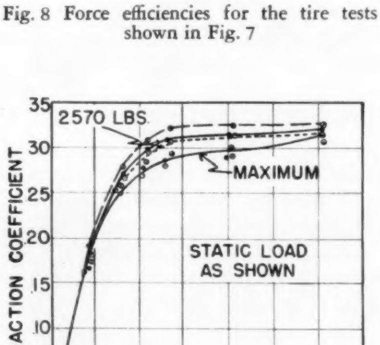


Fig. 9 *(Left)* Traction coefficients for tests shown in Figs. 7 and 10 (Tire symbols for the 2570-lb loading are as used in Fig. 7)

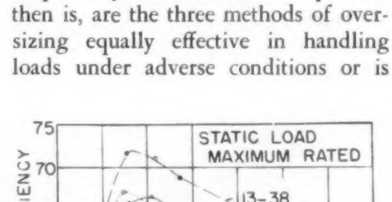


Fig. 11 Force efficiency for tests shown in Fig. 10. The efficiencies are approximately the same as for the tires loaded to 2,570 lb, Fig. 8

TABLE 3. TIRE INFORMATION FOR TIRES AS USED FOR TESTS IN FIGS. 7 AND 10

(All tests in Lakeland sand)

Tire	Inflation psi	Maximum rated load, lb	Rolling radius ft	Water for 85% fill, lb	No. of lugs
11-38	12	2185	2.371	405	24
12-38	12	2570	2.458	500	23
13-38	12	3050	2.544	600	23
11-38	14	2390	2.346	405	24
12-38	14	2810	2,454	500	23
13-38	14	3330	2.529	600	23

TABLE 4. CONDITION OF LAKELAND SAND FOR TESTS SHOWN IN FIGS. 7 AND 10

Range, in	For Tests Fig. 7 Water, percent	Volume weight	For Tests Fig. 10 Water, percent	Volume weight
0 - 2½	2.3	1.37	2.9	1.34
2½ - 5	4.3	1.43	3.4	1.49
5 - 7½	5.4	1.45	3.8	1.49

one method enough superior to the others to offset its extra cost or other shortcomings?

Extensive field tests, using several sizes of tractors equipped with regular size tires and oversizes that maintain the normal axle height and in varying field conditions, were made by the tire test subcommittee of SAE. This group requested that tests be made on at least one size group under the controlled conditions at the USDA tillage machinery laboratory also. The groups of tires shown diagrammatically in Figs. 2 and 3 were selected for this comparison. The five sizes of tires all have approximately the same outside diameter and axle height and use 38-in rims. The four 13 and 14-in tires are oversizes for the 12-38 tire.

Results for tests of these five tires in three soils—Lakeland sand, Hiwassee sandy loam, and Lloyd clay—are shown in Figs. 4, 5, and 6. The conditions for the soils as used for these tests are shown in Table 1. The tire with the smaller cross section had a slight advantage in both the total amount it would pull at a given slippage in the very loose sand and sandy loam soils but there was no measurable difference in the performance of the five tires in the slightly packed clay soil. The force efficiency curves, Fig. 5, and the traction coefficient curves, Fig. 6, show approximately the same trends. Force efficiency is thrust of the tire on the soil, that is, the axle torque in pounds-feet divided by the rolling radius, divided into the drawbar pull and multiplied by 100 to give percent. Rolling radius, as used here, is radius of the tire obtained when the tire is traveling forward in the test soil under zero drawbar pull and the designated static load. Traction coefficient is the ratio between drawbar pull and dynamic load on the tire. All tires for this series of tests were loaded to 2,570 lb, the maximum load recommended by the Tire and Rim Association for 12-38 tires inflated to 12 psi. The recommended maximum loads for the other sizes, rolling radii of all tires in the three soils, water carrying capacity, and other factors are shown in Table 2.

Since oversizing rear tractor tires by methods that keep the axle height and outside diameter the same showed no consistent advantages for oversizing if weight was kept constant, tests were made to determine the effect of oversizing by the method shown in Fig. 1 in which both the cross section and outside diameter are increased. Three tires, 11-38, 12-38, and 13-38 were used for these tests. These sizes were selected as 14-38 tires were not available. All tires were 6-ply rating and made by the same company. The results for tests on these tires are shown in Figs. 7, 8, and 9. These data show that, though the difference is slight, the oversize tires consistently pulled more at all percentages of slip and were more efficient in applying the force to the soil.

Each point shown is the average for replicated tests and, though the differences are slight, there was no overlapping of data when all tests were plotted. Here again the three tires were carrying the same load, 2,570 lb, the recommended load for the 12-38 tire at 12 psi, though the 11-38 was overloaded and the 13-38 was carrying less than its maximum rated load as shown in Table 3. The condition of the soil as used for these tests is shown in Table 4.

Data for the above three tires in Lakeland sand, each inflated to 14 psi and carrying the maximum recommended load, are shown in Figs. 9, 10 and 11. The increased load on the larger sizes causes them to exert a much greater drawbar pull at any slippage than the smaller tires. This is in line with results others have obtained from field tests. Comparing the data in Figs. 8 and 11 shows, however, that the force efficiencies for each tire are approximately the same for both loads. It is interesting to note that also the curve showing the results of tests on the 12-38 tire inflated to 12 psi and carrying 2,570 lb, Fig. 7, is almost the same as the curve for the same tire inflated to 14 psi and carrying 2,810 lb, Fig. 10. This is indicative of a relationship between tire load, inflation, and deflection for tires operating in certain soil conditions. Tests planned to establish this relationship and to determine the effect of oversizing rear tractor tires on soil packing are being made.

Conclusions

Results of these tests, verified by unpublished field data for tests made by the SAE tire test subcommittee and the developing and testing departments of tire and tractor manufacturers, indicate the following conclusions:

1 Oversizing tires by methods which keep the outside diameter of the tire the same show no advantage to the tractor used if the weight on the tires is kept the same.

2 There are no performance advantages for low section height tires for the conditions covered in these tests.

3 Tires oversized by the method which causes the outside diameter of the tire to increase as the cross section increases gave slightly increased drawbar pull and were more efficient in the application of the force to the soil.

4 The ability of oversized rear tractor tires to improve tractor performance is largely a function of the additional weight that can be safely carried by the larger tire where engine power is not a limiting factor. The amount of water required to fill each tire to 85 percent capacity is shown.

Airplane Spray Patterns

(Continued from page 601)

sively high deposit peaks. Although the fine spray gave a slightly wider and more uniform swath than the medium one, this small advantage was overshadowed by the higher loss of the fine spray. Therefore, it is concluded that a spray of medium atomization (150 microns mmd) provides the most efficient swath pattern for forest spraying.

References

1 Davis, J. M. A photographic method for recording size of spray drops. U.S. Department of Agriculture ET-272, July 1949.

2 Miller, J. M. and Isler, D. A. Dual spray equipment for airplane spraying tests. U.S. Department of Agriculture. ET-294, March 1951.

NEWS SECTION

Lanham Succeeds Lehmann

FRANK B. LANHAM has resigned as secretary of the American Society of Agricultural Engineers to become head of the agricultural engineering department, University of Illinois, September 1, succeeding E. W. Lehmann. Mr. Lanham joined the ASAE central office staff as assistant secretary in April 1952, becoming Secretary of the Society in July 1953.

A native of West Virginia, Mr. Lanham received a B.S. degree in agricultural engineering in 1935 from Virginia Polytechnic Institute. Following graduation, he took advanced work in agricultural engineering at Iowa State College on a fellowship during 1935 and 1936 and was awarded an M.S. degree. From 1936 to 1941 he was research agricultural engineer at the University of Georgia.

Mr. Lanham served in the Army during World War II, from 1941 to 1945, and in January 1946 he joined the Bower Company, wholesale hardware jobbers at Bainbridge, Ga. He left the firm in 1950 to accept an industrial fellowship at Iowa State College where he received the Ph.D. degree in agricultural engineering in 1952.

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(EDITOR'S NOTE: The following exchange of correspondence between Mr. Lanham and President Worthington concerning the former's resignation as Secretary of ASAE is reproduced here for the particular information of Society members.)

Mr. Wayne H. Worthington, President
American Society of Agricultural Engineers
Waterloo, Iowa

Dear President Worthington:

The Board of Trustees at the University of Illinois has approved the recommendation of President Morey that I become head of the agricultural engineering department at that institution, effective September 1, 1955. About the middle of August, I will begin a terminal vacation which will mark the close of my service as secretary of the Society.

It is with mixed feelings that I relinquish my present duties and responsibilities. I have regrets for the many opportunities for service to our Society and profession which have, for one reason or another, been allowed to pass by undeveloped. On the other hand, I find much satisfaction in the progress which has been made during my tenure. Mention could be made of several specific projects which suggest the forward-type thinking, the ability and eagerness of the ASAE when properly stimulated to think and act "tall".

The greatest single reward which comes to the secretary is the privilege of serving the finest professional group to be found anywhere. The cooperation of members individually and through organizations within the Society is a thrilling experience and one which I shall never forget.

I wish I could personally acquaint each member with my deep feeling of gratitude for the cooperation extended to me as secretary. Since this is clearly impossible, I will appreciate whatever action you may see fit to take to disseminate my thanks as widely as possible throughout the Society.

Sincerely,
FRANK B. LANHAM

St. Joseph, Mich., July 25, 1955

* * *

Dr. Frank B. Lanham, Head
Department of Agricultural Engineering
University of Illinois
Urbana, Illinois

Dear Dr. Lanham:

You will shortly be taking up your new duties at the University of Illinois—the realiza-

FRANK B. LANHAM

tion of a goal for which you and Mrs. Lanham, driven by ambition and a compelling sense of destiny, have so bravely and steadfastly dedicated these many years of your lives. I know of no better testimony to those things which made this country great — the dreams of the boy, the visions of youth, the setting up of clear objectives, the sustaining faith that drives away discouragement when doubts assail us, when all but the dim outlines of our dreams are obscured; the painful hours when we stand in indecision at the crossroad. With stalling suddenness, the curtain draws aside; we face the Great Opportunity with its many challenges. Well prepared, we step ahead with confidence.

Your work with ASAE has been as noteworthy as it has been difficult. You have served in the time of transition — when the Society suffers "growing pains" as it struggles to develop the stature to meet its rapidly increasing challenges and responsibilities. You have dreamed dreams for us, tirelessly striven to awaken a realization of our opportunities as individuals and obligations toward others. Unfortunately the trees one plants and nurtures bear fruit for others, but for your efforts and devotion we are grateful and appreciative. Your ideals and influences will long remain.

No career is more worthy or rewarding than the selfless directing and training of young men who are so soon to take over the unfinished tasks left them by an earlier generation. You will dream new dreams, and in your efforts to make them come true you will be awarded the satisfaction and peace of soul of seeing them become a part of the lives of others, and in turn passed along to still others.

For many years one of the best things that could be said about a young engineer in agriculture has been: "He is one of Emil Lehmann's boys." No man builds his own stature. It is determined for him by his deeds and the men whom he has moulded and developed. No one ever "takes another's place." We can only make our own place, and try to make it better. But we—your many friends in ASAE—not only wish you well, but have every confidence in your abilities and in you as a man. The time will soon be when young men can say with pride: "I am one of Frank Lanham's boys."

And in conclusion, Frank, as you leave ASAE, it is our hope and trust that you never get entirely away. You have our confidence, and we wish you and Mrs. Lanham every happiness and an overflowing measure of success.

Sincerely,
W. H. WORTHINGTON

Waterloo, Iowa, August 29, 1955

ASAE Meetings Calendar

(Refer to page 622)

MSU's Centennial of Farm Mechanization

THE Centennial of Farm Mechanization commemorating 100 years of farming and farm equipment progress and lauded as the world's fair of farming was held August 15 to 20 in honor of the founding of Michigan State University.

The giant show was opened officially by Allan B. Kline, president of the International Federation of Agricultural Producers and former president of the American Farm Bureau Federation, at a ribbon-cutting ceremony on Monday, August 15, 1:30 p.m. in the gateway to the exposition.

Early arrivals included the touring group of Russian agriculturists who arrived at the exposition midway on Farm Lane of the University campus shortly before 11 a.m. of opening day. They split immediately into small groups to tour the demonstration and exhibit areas.

Over 600 exhibits, valued at 20 million dollars, covering over 100 acres and including the largest display of farm machinery, old and new, ever assembled in this country awaited an estimated throng of more than a quarter million visitors. Practically all major farm equipment producers displayed their products and automobile manufacturers displayed their standard lines as well as their "dream" cars. Commercial and educational displays portrayed advancements made in the past century in power, machines, transportation, electricity, communication, buildings, home furnishings and soil conservation.

A pageant, "Land of Plenty," depicting the changes in farm life as experienced by four generations, was presented twice daily. As the years progressed the interior of an open farm home was changed with the period and the cast was costumed in the style of the era.

Outdoor exhibits included irrigation and tiling demonstrations, the old threshermen's roundup, and a tug of war between old-time giant steam tractors.

The task of conceiving and putting into action the plan for this spectacular farming exposition was performed by the Michigan State agricultural engineering department. A. W. Farrall headed the planning since its beginning nearly two years ago.

H. F. McColly served as assistant general chairman and headed machinery displays, R. L. Maddex was executive chairman and E. H. Kidder supervised special centennial programs and was in charge of soil and water demonstrations. Publicity was under the direction of Carl F. Albrecht. Other members in charge of display areas were: D. P. Brown, household exhibits; C. W. Hall, industrial, transportation and historical exhibits, and R. G. White, demonstrations.

Also in charge of various exhibits were W. M. Carleton, old threshers; J. S. Boyd, structures; D. E. Wiant, rural electrification; C. M. Hanson, pageant; and C. J. Mackson, transportation.

Centennial citations were presented to outstanding Michigan farmers, and to prominent business, agricultural and engineering leaders and scientists. Among the recipients were J. Brownlee Davidson, professor of agricultural engineering of Iowa State College and first president of ASAE, and Raymond Olney, editor and publisher of AGRICULTURAL ENGINEERING.

HOW TO TIGHTEN UP ON FARM PRODUCTION COSTS

Faced with the challenge of boosting farm profits, ag engineers are looking for new production tools to reduce operating costs. And among the most important tools on any farm are its buildings.

The answer to this need for low-cost, functional farm shelter is *steel buildings.* Modern farmers can't afford to spend the time needed to erect old-fashioned conventional structures. Steel buildings go up fast. Inexperienced farm hands can do the job quickly and easily with ordinary wrenches.

Because they're fire-resistant, steel buildings can be put close together in a compact layout. And as a farm's needs change, these buildings can be moved or added to without loss of materials.

Steel buildings painted white outside reflect the summer sun, help keep interiors cool. No other uninsulated building material gives better results. This means more comfortable quarters for livestock and better working conditions for the farmer.

To keep building maintenance at minimum, many manufacturers of steel farm buildings use Armco ZINCGRIP—a specially zinc-coated steel that gives long protection against rust. In 18 years of service, ZINCGRIP has proved itself as the dependable, low-upkeep steel for farm use.

If you are designing steel buildings or equipment, you can obtain further information on this special sheet steel by sending the coupon below.

A steel building like this machinery shed can be put up by an inexperienced crew in a few days after the foundation has been laid. This includes installation of all doors and windows—which can be added wherever and whenever needed.

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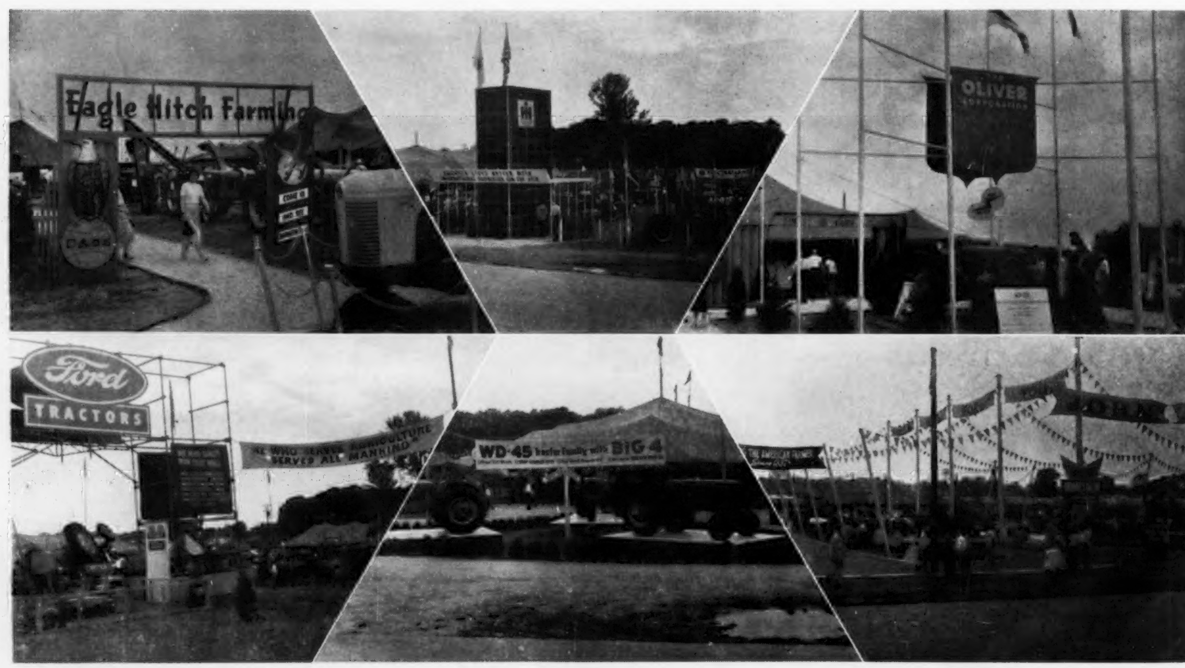
On-the-Scene Snapshots of MSU's Centennial of Farm Mechanization

(Left) Gateway to the Farm Mechanization Centennial Exposition held August 15 to 20 on the campus of Michigan State University marking 100 years since the founding of the university. • *(Center)* Allan B. Kline, president of International Federation of Agricultural Producers and former president of the American Farm Bureau Federation, officially opened the Centennial of Farm Mechanization Monday, August 15. Witnessing the ribbon-cutting ceremony is John A. Hannah, MSU president. • *(Right)* Members of the Russian farm delegation visiting the Centennial exposition were escorted by W. M. Carleton *(second from right),* Michigan State professor of agricultural engineering *(left to right)* Aleksandr Ezhevski, engineer and deputy minister, automobile tractor and agricultural machine building, USSR; Dimitrii Kostuhin, Soviet embassy; Carleton, and Constantin Nikiforoff, interpreter, U.S. Soil Conservation Service

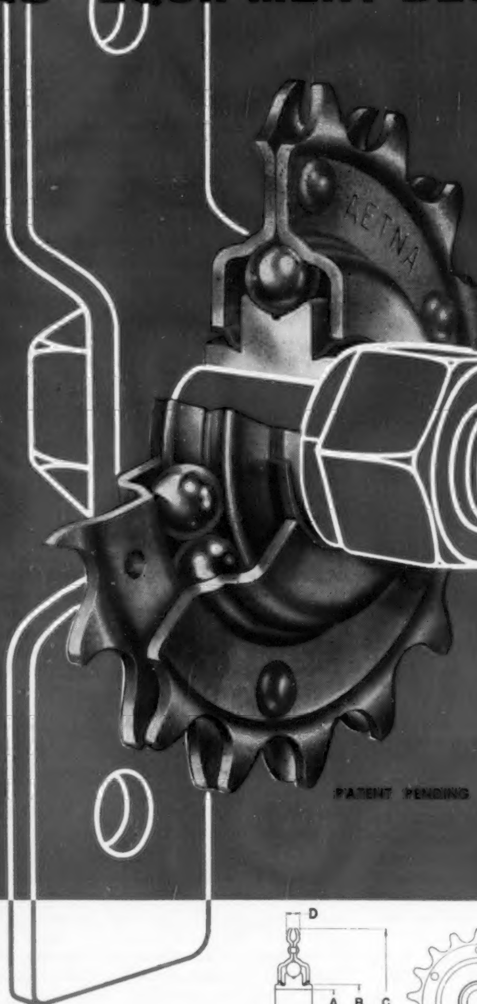
Heart-warming scene taken from the colorful pageant that dramatized the life of a farm family from the days of the horse-powered thresher and one-man corn planter to the present-day powerful combines and tractors. The pageant was presented twice daily during the Centennial of Farm Mechanization. Shown is an early steam traction engine

Future agricultural engineers visiting the booth of the American Society of Agricultural Engineers located in the MSU agricultural engineering building. The boys are brothers, Philip (8) and William (14) Butcher, Belleville, Mich.



Shown above are some of the many farm machinery exhibits at the Michigan State University Centennial of Farm Mechanization. The exposition reportedly brought together the largest assembly of farm implements, old and new, ever seen in the USA

"AG" EQUIPMENT DESIGNERS!



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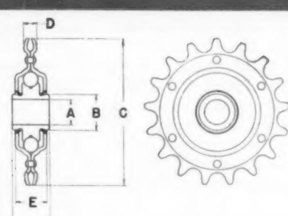
This original and revolutionary, single *package* design permits low initial cost; maximum compactness; easy, speedy assembly line installation. You'll want its pronounced advantages in your new farm machinery designs. In your current models, too! The change-over involves only minor engineering alterations.



Bearing Number	DIMENSIONS								
	Pitch	Roller Dia.	No. of Teeth	A	B	C	D	E	F
AG-2416	⅝"	.400"	17	⅝"	⅞"	3⅝"	5/16"	51/64"	.927"
AG-2416-B	1¼"†	.400"	9	⅝"	⅞"	3 55/64"	5/16"	51/64"	.927"
AG-2417	¾"	15/32"	15	⅝"	⅞"	3 29/32"	7/16"	51/64"	.927"
AG-2417-B	1½"†	15/32"	7	⅝"	⅞"	3¾"	7/16"	51/64"	.927"
AG-2419	1" †	.312"	11	⅝"	⅞"	3 25/32"	¼"	51/64"	.927"
AG-2422	1.654"	#62*	7	⅝"	⅞"	4¼"	13/16"	51/64"	.927"
AG-2423	1.631"	#55*	8	⅝"	⅞"	4¾"	11/16"	51/64"	.927"

†Extended pitch *Detachable steel chain

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Emil W. Lehmann retired September 1 after 34 years as head of the agricultural engineering department at the University of Illinois. Mr. Lehmann became the department's first head in 1921 and has been responsible for its continued growth to where it now employs 25 full-time academic staff members.

Immediately upon retirement, Mr. Lehmann joined the International Harvester Co. as special representative of the vice-president in charge of the farm implement division. In his new job he will act as liasion between farmers and the company's farm equipment engineering and manufacturing units. He will work closely with dealers and district sales offices, as well as with county agricultural agents and farm groups.

Mr. Lehmann was born on a plantation near Oldenburg, Miss., in 1887. He received his B.S. degree in electrical engineering from Mississippi A & M College in 1910. From 1910 to 1913 he served as an instructor in physics at the A. & M. College of Texas. During this time he did summer work at Cornell University and at the University of Wisconsin. In 1913 he was awarded the professional degree of electrical engineer from Texas A. & M. For his thesis he made what was the first rural electrification study. This whetted his interest in agricultural engineering, and soon he entered Iowa State College on a research and teaching fellowship. He earned a B.S. degree in agricultural engineering and stayed on at Iowa State College for two years as assistant professor of agricultural engineering.

Mr. Lehmann became head of the agricultural engineering department of the University of Missouri in 1916. In 1919 he returned to Iowa State College to receive the professional degree of agricultural engineer. After a short time as agricultural engineering editor of *Successful Farming,* he joined the faculty of University of Illinois and has been agricultural engineering department head since that time.

Mr. Lehmann served as president of ASAE in 1922 and has been active in the Society since 1916. When the airplane came into general use for agriculture, he proposed and was first chairman of an ASAE agricultural aviation program at the annual meeting at Houston, Texas, in 1951. He served on various Society committees including the advisory committee for the Museum of Science and Industry of Chicago; the Farm Structures committee on farm sanitation, and the committee on industry seminar.

He proposed the idea of the National Farm Safety Week and was first chairman in 1943. He organized the first Farm Equipment Institute-sponsored industry research conference.

His foresight and untiring efforts were responsible for many advances that have been made in crop drying, hay crushing, and automatic feed grinding and handling.

Despite his varied activities, Mr. Lehmann was co-author of a farm mechanics textbook, the author of four chapters in a farmers' encyclopedia published in 1918, and later prepared material for *Encyclopedia Britannica* and *American People's Encyclopedia.* He is also author of many bulletins and circulars, as well as numerous articles that have appeared in various farming magazines.

•

Charles E. Rice has resigned as a member of the agricultural engineering staff of Michigan State University to accept a position in the agricultural engineering department, University of Georgia, Athens.

ASAE MEMBERS in the News

E. W. Lehmann

K. L. Magee

J. H. Dasenbrock

H. E. Gulvin

J. Henry Dasenbrock has been appointed as product education manager at New Idea Farm Equipment Co., Coldwater, Ohio. In his newly created position, Mr. Dasenbrock will be responsible for preparation and execution of all product education programs of the company. These programs will make extensive use of slide films, movies, and other educational techniques.

Mr. Dasenbrock has done similar work for the past six years for Harry Ferguson, Inc., and Massey-Harris-Ferguson, Ltd., at Detroit and Toronto, Canada. Earlier, he worked for eight years in overseas relief and reconstruction activities of the American Friends Service Committee in France, Poland and Mexico.

•

Harold E. Gulvin, formerly assistant professor of mechanized agriculture at the University of Rhode Island, has been appointed to the staff of the Eastern States Farmers' Exchange, West Springfield, Mass. His new work will be devoted to applied research, including evaluation and re-evaluation of farm supplies handled by Eastern States.

Mr. Gulvin graduated from Cornell University, receiving a B.S. degree in agriculture. In 1946 he received an M.Ed. degree from the University of Buffalo. For 16 years he taught vocational agriculture and conducted classes during World War II for the Food Production War Training Program to help farmers repair machines when parts were not available.

Mr. Gulvin is the author of numerous agricultural engineering articles as well as author of a book, "Farm Engines and Tractors." He is co-author of a revised edition of "Machines for Power Farming."

•

Pierre J. Jutras recently accepted a position at the University of Maine as research assistant in the agricultural engineering department. He will be handling research on new forage-handling methods and equipment under a grant from the Hood Foundation. He has recently been assistant service supervisor for Cockshutt Farm Equip., Ltd.

Kenneth L. Magee has been named director of product engineering, of the J. I. Case Co., Racine, Wis. In his new job he will assist the company president in directing and coordinating the engineering programs of all Case plants. In addition, he will directly supervise staff departments including dynamometer, patent and standards at Racine.

A graduate of the University of Wisconsin, Mr. Magee holds degrees in civil and mechanical engineering. Graduating in 1931, he worked for the Wisconsin soil erosion control service until 1933 when he joined the U.S. Army Corps of Engineers. In 1936 he joined the J. I. Case Co. as chief engineer of the Burlington, Iowa, works and later became chief engineer of the Rockford, Ill., works.

•

Robert C. Evans has been appointed as senior project engineer for New Idea Farm Equipment Co., Division of Avco Mfg. Corp., Coldwater, Ohio. Mr. Evans was a member of the advanced engineering group at International Harvester Co., Chicago, for four years and also served as their assistant zone manager in Green Bay, Wis., for six months. He was graduated from Ohio State University in 1950 with a B.S. degree in agricultural engineering. In 1949-50 he served as national president of the ASAE Student Branches.

•

William T. Robertson, Jr., recently completed a tour of extended active duty with the armed forces and has become assistant fuel purchasing agent of the Mill Power Supply Co., Charlotte, N. C., a subsidiary of the Duke Power Co.

•

Charles T. Bourns has announced the formation of a new agricultural engineering consulting service, to be known as the Charles T. Bourns & Associates, Agricultural Consultants. The association consists of Mr. Bourns, (Member ASAE), Eldred A. Jordan, (Affiliate ASAE), and Audrey A. Howard. Offices will be located in Room 805, Jones Bldg., Corpus Christi, Tex.

Mr. Bourns formerly was an associate professor of agricultural engineering at Texas Technological College, Lubbock, and is a registered engineer in Texas and New Mexico. He has also worked several years in Latin America and speaks both Spanish and Portuguese. Mr. Jordan also was an instructor in agricultural engineering at Texas Technological College before joining the new firm. Mr. Howard is an agricultural engineering graduate from Texas Technological College.

•

Carson Carmichael, Jr., until recently power engineer for the Appalachian Electric Power Company at Abbingdon, Va., is now on active duty with the U.S. Air Force, Air Development Center, Wright-Patterson Air Force Base, Dayton, Ohio

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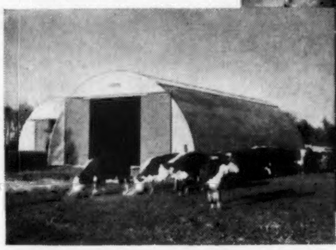
Delbert P. Schwab, who has been serving as field representative of Douglas Fir Plywood Association in Georgia, recently resigned to accept employment as irrigation specialist with the Oklahoma Agricultural Extension Service. His new address is 1308 N. Academy, Guymon, Okla.

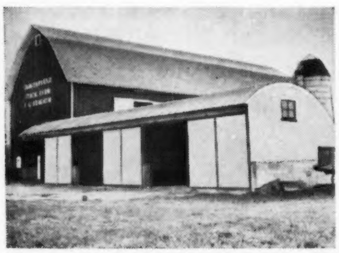
•

A. Aly Ibrahim, who has been pursuing a post-doctoral fellowship in agricultural engineering at Purdue University, recently left for his home in Egypt where he will be in charge of agricultural engineering work in the College of Agriculture at Chatby, Alexandria. *(Continued on page 622)*

An insulated interior lining makes the 40 x 20 shop end of the Borcherding Quonset 40 x 80 a comfortable place to work both in winter and summer.

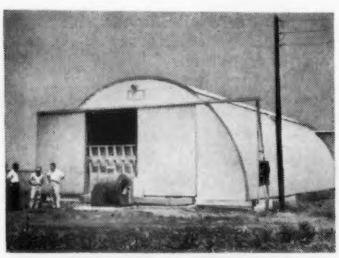


"You might call us a 'Quonset family,'" says Hugo Medow, Seward, Neb. "I liked my machine shed so well that I have since got another Quonset 32 x 60 building that I use as a cattle barn."



"My Quonset 24 x 72 machinery storage building gives me plenty of headroom and floorspace at a price I can afford to pay," says F. Gordon Stockin, Chaffee, N.Y.

This is the shop section of the Quonset 24 x 84 which serves as a machine and tool shelter, pump house, and farm shop for P. H. Hanes, Jr., Clemmons, N.C.



Harlan Kelly, Aqua Dulce, Texas, converted his Quonset 32 x 60 machinery building to grain drying and storage. He says, "Very pleased with its versatility."

Add years of life to your equipment with a Quonset® machinery storage and farm shop building

"Keeping our equipment out of the weather in our Quonset adds up to 50 per cent to its trade-in value—one year of weathering is worse than five or six years of actual use," says G. W. Borcherding, Moore, Montana. "And we save time with our Quonset 40 x 80 machinery storage and farm shop building." adds Mr. Borcherding, "because we can put our equipment in shape during bad weather. Having equipment ready to go helps get the job done on time—which means dollars in any farmer's pocket."

The Quonset on the Borcherding ranch is adaptable to other uses, too—it serves as a grain storage building when needed.

A Quonset farm machinery storage building will save money, time and labor for you, too. See your Quonset dealer today.

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NEW PRODUCTS CATALOGS

Needle Bearing Catalog

The Torrington Co., Torrington, Conn., has released a new illustrated catalog presenting design, application and use data for five types of needle bearings.

The new catalog, designated as No. 55, contains fundamental engineering information on bearings and is organized for practical use in properly selecting bearings by type, size and suitability.

Index visual units speed identification of bearings and thumb guides are keyed to the index. Dimensional data and visualization of product application are presented on facing pages as a time saver. Descriptive material on each type of bearing details design considerations, construction, materials and finishing, lubricating, housing and shaft requirements, fits, load capacities and recommended installation methods.

New Micronic Air Filter

Purolator Products, Inc., Rahway, N. J., has developed a new dry-type micronic air filter for heavy-duty truck, bus and tractor operation. The new impregnated cellulose filter element reportedly removes solid particles of submicronic size from air entering diesel or gasoline engine combustion chambers.

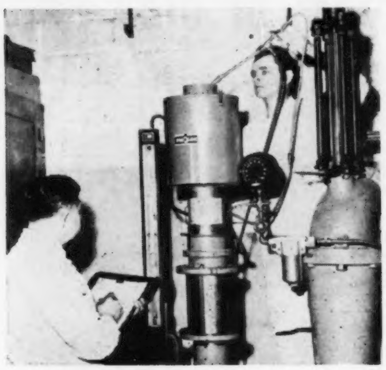


Illustration shows laboratory tests in which engineer on right introduces measured quantities of AC dust contaminant, while another technician observes pressure drop across the filter element. The element is later weighed on sensitive balance to determine percentage removal from air of contaminating particles.

Combine Corn Attachment

Deere & Company, Moline, Ill., has announced a new No. 10 two-row corn attachment for its model 45 self-propelled combine.

In this new attachment, corn is snapped and augered directly into the combine threshing unit. The rasp-bar cylinder is said to shell corn satisfactorily with moisture content up to 25 or 30 percent. The

separating and cleaning units have sufficient capacity without extra equipment.

The company reports that the corn attachment and the regular 8 or 10-ft platform of the model 45 combine can be interchanged by two men in less than an hour.

Pressure Control

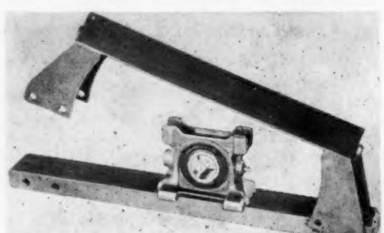
The Rochester Mfg. Co., 9 Rockwood St., Rochester 10, N. Y., has announced a new pressure switch available in both single and

double-terminal models. The new gage, encased in a stamped-steel, hermetically sealed case also features close on and off settings. It reportedly holds precise cutin, cutout settings consistently under test installations. A spring-loaded diaphragm in a special seat design can be equipped with optional additional overload protection in the form of a special stem-located dampener mechanism.

The gage measures $1\frac{3}{4}$ in wide and $2\frac{1}{16}$ in from top of terminal to end of fitting. It is also available with $\frac{1}{4}$-in or $\frac{1}{8}$-in threaded fitting. The pressure range is up to 100 lb.

Improved Takeup

Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill., has introduced its improved DS takeup for use on a variety of materials handling equipment such as apron, belt, chain, drag, flight and slat conveyors.



A new one-piece hinged top frame permits access to the bearing block and adjusting screw. The top swings upward after three bolts are removed from the base. The new takeups are interchangeable with previous designs and are available with babbitted, ball or roller bearings. The babbitted blocks have a pipe top for grease cup or fitting. The ball or roller bearing blocks come with hydraulic-type fittings. Takeups are available for shaft sizes from $1\frac{15}{16}$ to $3\frac{15}{16}$ in diameters with adjustments from 12 to 30 in.

Non-Technical Book on Tool Steels

Crucible Steel Company of America has announced the availability of a newly revised 44-page book on tool steels for the non-metallurgist. The book is written to present a practical understanding of tool steels without being overly technical and is intended to familiarize the non-metallurgist with the six basic classifications of tool steels. Properties of the various types of tool steels are discussed and recommendations are made suitable application by type.

Copies can be obtained by writing to the Advertising Dept., Crucible Steel Company of America, P.O. Box 88, Pittsburgh 30, Pa.

Larger Flexible Shaft

Stow Mfg. Co., 39 Shear St., Binghamton, N. Y., has developed a new $1\frac{1}{4}$-in-diam flexible shaft, which, the manufacturer reports, can transmit up to 1650 lb-in of torque at 440 rpm.

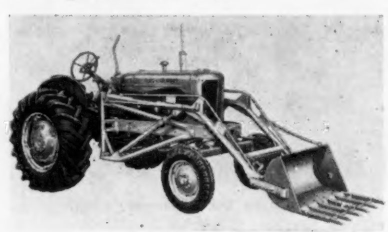
The core of the new shaft is made up of layers of tightly wound music wire. The casing is lined with oil-tempered spring steel, reinforced with wire braid, covered with oil-resistant neoprene-impregnated fabric and an abrasion-resistant rubber jacket. The casing serves as the bearing surface for the core and also retains the lubricant. Steel-backed bronze sleeve bearings are provided

at each end of the shaft. End couplings of various bores are available. Also, square slip joints, 18 in long, are available for connection at one end to take care of change in length when a tractor-trailer might jackknife.

New A-C Loader

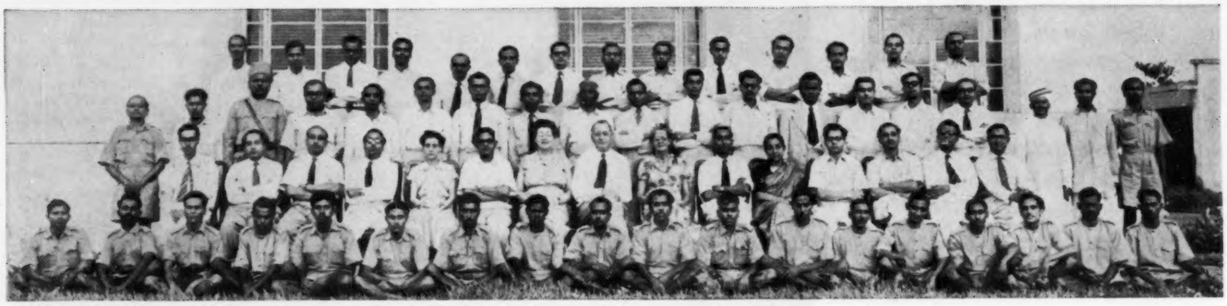
Allis-Chalmers Mfg. Co., Milwaukee, Wis., has announced the addition of a hydraulic front-end farm loader to its farm equipment line. The new loader is available in two sizes, both hydraulically operated, and features drive-in attachment and easy back-out removal.

The model 8 is designed for the CA tractor. It has a 36-in wide, 8-cu-ft-capacity bucket, with a maximum lift of 8 ft. The model 9 is for the WD series tractors and has a 10-ft lifting height for its 40-in wide, 9-cu-ft-capacity bucket. Both buckets are equipped with slide-in dirt plates and replaceable $1\frac{1}{8}$-in-square steel tines. The loaders can be operated without shifting tractor gears and when tractor is either standing still or in motion.



(Continued on page 618)

ANY PROBLEMS FOR THESE RESEARCHERS?



The Indian Jute Mills Association Research Institute (IJMARI) of Calcutta, India. Over 80 scientists, technologists and other workers devote their entire attention to the testing and development of jute and jute fabrics in six separate but related groups. These are Background Research, Applied Research, Development Research, Technical Service, Standardization, and Information Service. Among the many valuable contributions made by the Research Institute to the cause of improving jute products and their utility as packaging and industrial fabrics, are the development of a rot-proofing process and a method of bleaching and softening burlap; as well as the use of an asphalt-impregnated jute fabric in war-time construction projects which demonstrated a principle which may soon be successfully applied to important agricultural uses. The work of this staff has directly benefited American agriculture and industry through the advances in the quality and performance of burlap, and the adaptation of the fibre to new uses where it has effected a saving of time or money.

DR. W. H. MacMILLAN, Ph.D., B.Sc.— Research Director of the Institute who first came to Calcutta in 1937 as chief chemist of the Indian Jute Mills Association. He is the author of over 50 scientific and technical papers and plays an important part in the scientific and textile societies

of India. He is Chairman of the Calcutta section of the Textile Institute of Great Britain and Northern Ireland. His assistance is available for the solution of any problems submitted on behalf of American agricultural and industrial engineers.

This modern, completely air conditioned building which houses the IJMARI staff was opened on January 2, 1952 by Prime Minister Nehru. It contains a lecture room, vast libraries, a display room, and 17 laboratories. It is typical of the "new" India in which jute plays an important role as the country's largest dollar earner and figures prominently in the country's determination to meet and exceed the high standards set by the American market.

How to put the IJMARI staff to work on your problems

Burlap — agriculture and industry's toughest and most versatile fabric—is playing new and varied roles all over the world today. Take advantage of the complete research facilities at IJMARI for any projects you are working on. You can easily arrange this through Wm. A. Nugent, Vice President, The Burlap Council, 155 E. 44th St., N. Y. 17.

Published by The Burlap Council of the Indian Jute Mills Association
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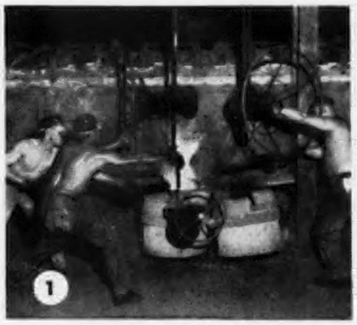

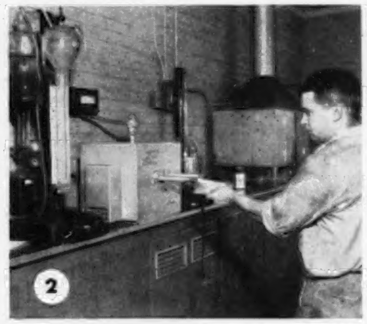

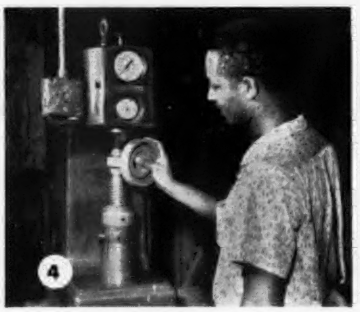


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New Products and Catalogs

(Continued from page 612)

New Spreader Line

New Idea Farm Equipment Co., Coldwater, Ohio, has announced a new line of 8, 10, and 12-ft fertilizer spreaders with reversible, water-tight covers, detachable hopper bottom and a front-mounted grass seeder.

The company reports that the new spreader will spread any fertilizer in any condition in any amount from 10 to 5000 lb per acre.

Water-tight covers are secured with a cam handle and are designed to open from front or rear. Lid stops aid bulk loading and the covers lift separately.

Flanges on top of the box turn outward so the spreader can be overturned for cleaning. The hopper bottom can be removed for periodic cleaning or replacement. A case-hardened agitator is designed to give positive feed action and makes the machine virtually self-cleaning when oily sand or sawdust is run through.

Zinc Coating Booklet

The American Zinc Institute, 60 East 42nd St., New York 17, N. Y., will send on request to interested readers its new 32-page illustrated booklet, "How Zinc Controls Corrosion".

The book describes galvanizing and other processes by which zinc coatings are applied to iron and steel. Drawings, charts, and photographs together with brief comments present the corrosion-control characteristics of zinc coatings, zinc pigments, and zinc anodes.

95-Bushel Spreader

J. I. Case Co., Racine, Wis., has announced its new Model 95 manure spreader which features light draft and roller-chain drives.

All the beater drives from axle to main beater, to upper beater and widespread — are by steel roller chains running on shell-molded sprockets. The two beaters and widespread are supported by anti-friction bearings. The axle runs in five roller bearings, the odd bearing being in the middle to

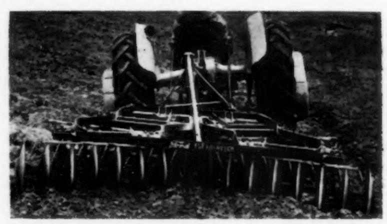
prevent springing of the axle and flaring of the wheels by heavy loads, rough ground or loader impacts.

The rear arch is tilted back to a position where it forms a guard for the upper beater and its side shields, protecting them from bumps by power loader forks. The arch also is adjustable for height. The box has sides and bottom of double-treated wood — both a penetrating preservative and a surface coating of protective paint. The hitch is self-raising and levers permit adjustments for hitch height and length.

Disk Harrow Has Floating Hitch

Tractor and Implement Division, Ford Motor Co., Birmingham, Mich., has introduced a new lift-type disk harrow that features a floating hitch. The new Flexo-Hitch allows the disk harrow to ride freely over deadfurrows, ditches, ridges and backfurrows, independent of the tractor's motion.

The new tool performs like a pull-type unit when in operation, but still retains the hydraulic lifting, lowering and transporting features of a lift type.



The floating action is accomplished through the use of L-shaped hinges where the lower implement links attach to the frame. Each of four disk gangs is angled individually from approximately 3 to 20 deg in 3-deg steps, to meet varying field conditions. Special spring-lock pins hold the gangs in any one of six positions for field adjustment without disassembly of the frame. Harrow pitch is controlled from the tractor seat with the adjustable top link of the tractor hitch. *(Continued on page 620)*

Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Brantingham, Paul T.—Manager of engineering, foreign operations, International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.

Carr, James P.—Assistant chief engineer, John Bean Div., Food Machinery and Chemical Corp., 1305 S. Cedar St., Lansing, Mich.

Clason, John W. — Advertising account executive, Campbell-Ewald Co. (Mail) 1506 Anita Ave., Grosse Pointe Woods 36, Mich.

Coates, Peter C.—Agricultural field representative, Stran-Steel Corp., Ecorse, Detroit 29, Mich.

Cuellar, Rafael — Agricultural engineer, Facultad de Agronomia, Palmira, Valle, Colombia, S. A.

Dannevik, William P.—Sales engineer, Able Irrigation Co., Uvalde, Tex.

Everhart, James R. — Rural representative, Indiana & Michigan Electric Co., 202 S. Washington St., Marion, Ind.

Goyer, David F.—Trainee, G. L. F. Farm Store, Middletown, N. Y. (Mail) c/o Mrs. Britt, 36 Bennet St.

Joerns, Hermann—Student in agricultural engineering, University of Florida. (Mail) Calle 2a No. 4-98, Cali, Colombia, S. A.

Jones, Dean E.—Engineer trainee (SCS), USDA. (Mail) 129 Union St., Edensburg, Pa.

Katona, Alex J.—Sales manager, Big Chief Mfg. Co., Hutchinson, Kans. (Mail) No. 7 E. 15th Ave.

Kaul, Ravindra N.—Assistant professor of agricultural engineering, B. R. College, Agra, U.P. India.

Keller, Henry J. — Agricultural engineer (SCS), USDA. (Mail) Box 823, Nacogdoches, Tex.

McElmurray, Jesse G. Jr.—Signal Co. officer, U.S. Army. (Mail) RR 4, Box 101, North Augusta, S. C.

McMicken, Clarence R.—1st vice-president, B. Hayman Co., Inc., Los Angeles 4, Calif. (Mail) 217 N. Rossmore

Merriam, John L. — Engineering specialist (SCS), USDA. (Mail) 4865 Park Ave., Riverside, Calif.

Mir-Motahari, Abdol H.—1280 Dean St., Brooklyn 16, N. Y.

Payne, Donald W.—Assistant county agent, Monroe County Extension Service. (Mail) 842 N. Aurora St., Ithaca, N. Y.

Portugali, Izrael — Mechanical engineer, Kfar Giladi Works, Galil Elion, Israel

Pearson, Myron L. — Field representative, steel, asphalt and building dept., United Co-Operatives, Inc., Alliance, Ohio. (Mail) 461 E. Broadway

Petersen, Donald H.—Agricultural engineer (SCS), USDA. (Mail) 125 S. Owens St., Stillwater, Minn.

Toland, Wayne G.—Chief engineer, product engineering dept., International Harvester Co. (Mail) 718 S. Tuxedo St., Stockton, Calif.

Vierck, Robert W. — Sales representative, Warner Electric Brake & Clutch Co. (Mail) 5th Ave. Bldg., Moline, Ill.

Transfer of Membership Grade

Cunningham, Ernest R. Jr.—Western editor, Design News Magazine. (Mail) PO Box 556, Libertyville, Ill. (Associate Member to Member)

New Products and Catalogs

(Continued from page 618)

New Traction Booster Tools

Allis-Chalmers Mfg. Co., Milwaukee, Wis., has announced an engineering development which permits the use of heavier implements than previously was used in the traction-booster system of the WD-45 tractor.

The so-called traction-booster system automatically provides for a transfer of weight from rear-mounted implements to the rear

tractor wheels for added traction when needed. Previously the system was applicable only to implements that were in proper weight ratio to that of the tractor's front end. The new concept is said to extend the application to implements of greater weight.

Coinciding with this announcement, the company also introduced a series of big-capacity implements to be used with the WD-45 tractor and designed to take advantage of the new system. These include the new No. 213 12½-ft double-action disk harrow, a 4-bottom No. 64 moldboard plow (shown), and a 4-blade No. 340 disk plow.

70-hp Tractor-Shovel Unit

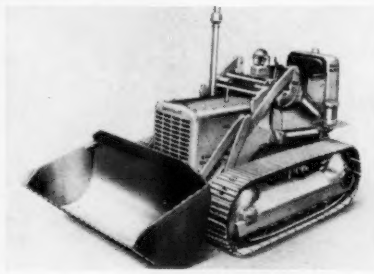
Caterpillar Tractor Co., Peoria, Ill., has announced its new integral tractor and shovel unit called the Cat No. 955 Traxcavator.

The new tractor-shovel is an adaptation of the Cat D4 crawler tractor. The general appearance, however, and location of major items such as the seat have been changed. The seat location with respect to the D4 is approximately 11¾ in higher and 4¾ in forward, and with respect to the Cat HT4 tractor-shovel, 9½ in higher and 11⅞ in forward.

A 40 percent tilt back of the 1½-cu-yd bucket at ground level permits maximum bucket capacity under a variety of conditions.

The full flow hydraulic oil filter is mounted on the left fender and the hydraulic valve and tank is fastened to the right fender. The hydraulic cylinders are located above the tracks to minimize the possibility of damage from mud and rocks. Long track roller frames are used to provide good stability and low ground pressures, while three-bar-lug track shoes are used for traction.

Batteries for either 6-v or 24-v starting systems are located beneath the fuel tank at the rear of the unit. An oil-type flywheel



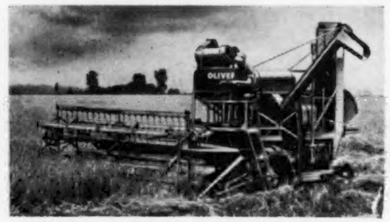
clutch is used. Two reverse speeds up to 264 fpm and four forward speeds up to 607 fpm are available.

The overall dimensions are: length 15 ft-1¼ in; width 80 in; height 82⅛ in; ground clearance 13⁷⁄₁₆ in; weight 21,480 lb.

Increases Capacity of S-P Combine

The Oliver Corp., 400 W. Madison St., Chicago 6, Ill., has announced that the handling capacity has been increased in the new Model 35 self-propelled combine.

Maximum cutting width in the new machine remains at 14 feet, but threshing, separating and cleaning units have been



designed to smooth out the flow of grain to handle a greater volume.

A new rod-type deflector has been placed behind the cylinder to permit free passage of material; straw walker agitation has been increased; and a herringbone-type concave is used.

The chaffer and shoes are separately driven at different speeds to effect a "winnowing" motion. The total cleaning area adds up to 5075 sq in on the straw walkers and 1575 sq in on the chaffer and shoe.

Included in Model 35 harvester line is a rice field model provided with track-type propulsion.

ASAE Meetings Calendar

October 7 and 8 — OHIO SECTION, Columbus, Ohio

October 13-14 — GEORGIA SECTION, Georgia Coastal Plain Experiment Station, Tifton, Georgia.

October 14 and 15 — FLORIDA SECTION, Gainesville, Fla.

October 19-21 — PACIFIC NORTHWEST SECTION, Heathman Hotel, Portland, Ore.

October 20-21 — PENNSYLVANIA SECTION, Holiday Motor Hotel, Gettysburg, Pa.

October 21 and 22—ALABAMA SECTION, Auburn, Ala.

October 22—MICHIGAN SECTION, East Lansing, Mich.

November 4 and 5 — VIRGINIA SECTION, Hotel Roanoke, Roanoke, Va.

December 12 to 14 — WINTER MEETING, Edgewater Beach Hotel, Chicago

December 29 and 30 — PACIFIC COAST SECTION, Tucson, Ariz.

February 6-8—SOUTHEAST SECTION, Atlanta, Georgia

June 17-20—49TH ANNUAL MEETING, Hotel Roanoke, Roanoke, Va.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.

ASAE Members in the News

(Continued from page 610)

Liston N. Drury recently accepted a position with the farm electrification section of the USDA and will be stationed at the University of Georgia, Athens. Previously he was instructor in agricultural engineering at the University of Tennessee.

Harold Holmen is now assistant professor of agricultural engineering and assistant agricultural engineer in the experiment station at North Dakota Agricultural College. He recently completed work for a master's degree in agricultural and civil engineering at South Dakota State College.

Wesley W. Gunkle, who has been pursuing advanced studies in agricultural engineering at Michigan State University, is returning to his former position as associate professor of agricultural engineering at Cornell University, Ithaca, N. Y.

Joseph B. Cocke, who has been employed as an agricultural engineer at the Special Fibers Laboratory, USDA, at Belle Glade, Fla., has recently been transferred to Clemson, S. C., where he will be employed in the USDA Southeastern Cotton Ginning Research Laboratory.

PERSONNEL SERVICE BULLETIN

NOTE: In this bulletin the following listings current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated.

POSITION OPEN—JANUARY—O-437-667, 438-668, 447-672. FEBRUARY—O-19-704, 32-705, 33-706, 18-709. MARCH—O-55-710, 61-713, 71-714, 87-715. APRIL—O-120-716, 125-718, 155-719, 143-720, 173-721. MAY—O-200-722, 197-723, 180-724, 196-725, 205-726, 214-727, 214-728. JUNE—O-244-731, 268-732, 248-733. JULY—O-267-734, 289-735, 303-738, 307-739, 316-740. AUGUST—O-305-741, 319-742, 325-743, 329-744, 324-745, 334-746, 338-747, 345-748, 346-749, 346-750, 347-751, 350-752.

POSITIONS WANTED—APRIL—W-114-8. MAY—W-176-19, 206-21, 182-22. JUNE—W-179-24, 203-25, 247-27, 250-28, 252-29, 245-30, 263-31. JULY—W-266-35, 265-37. AUGUST—W-308-38, 312-40

NEW POSITIONS OPEN

AGRICULTURAL ENGINEER for service in Bolivia, S.A., with International Cooperation Administration mission. Work will involve developing plans for farm irrigation systems, farm drainage and soil conservation structures; holding demonstrations; and training other extension workers in similar work. Age 30-55. BS deg in agricultural engineering or agriculture desirable but not essential. Several years experience in soil conservation organizations, or in same field wiith TVA or Bureau of Reclamation. Ingenuity, enthusiasm, teaching ability, tact, and ability to work with other nationals. Opportunities for advancement good, through changing jobs within the organization. Salary, $8270 per yr, plus allowances; 2 yr appointment. O-331-754

AGRICULTURAL ENGINEER, assistant or associate professor rank, for research and teaching in farm power and machinery and in rural electrification in a northeastern land-grant university and agricultural experiment station. Research will be main responsibility. Advanced degree in agricultural engineering with research experience in either field. Usual personal qualifications for public service research and college teaching. Good opportunity for ambitious research man in expanding department with good potential for further growth. Opening to be filled by October 1. Salary $5000-6000, depending on qualifications. O-363-755

AGRICULTURAL ENGINEERS (3 openings) for research in methods and equipment for grading agricultural products, with a new research organization in the USDA. Location East or South. Age under 35. BS deg in agricultural engineering required. Advanced degree preferred. Experience in agricultural processing and research instruments. Interest in research. Civil service position with usual opportunities and benefits. Salary $4,345-6390, depending on qualifications. O-335-756

AGRICULTURAL ENGINEER for product design of hydraulic and air blast sprayers, reciprocating pumps and related accessories, including layout and drawings for experimental units, supervision of tests and correlation of design with product engineering. Established manufacturer in Midwest. Age 25-35. BS deg in agricultural or mechanical engineering. Experience 3 to 5 yr in design and development, preferably on farm equipment. Farm background and some manufacturing experience desirable. Good character and personal references required. Opportunity for diversified experience. Liberal salary increases for proven ability. Salary open. O-340-757

AGRICULTURAL ENGINEER and assistant (2 positions) for research at main agricultural experiment station in a southern state. Age 30-45 for engineer; 25-35 for assistant. Advanced degree. Good researcher and cooperator. Excellent opportunity. New facilities recently provided. Salary open. O-352-758

AGRICULTURAL ENGINEER for teaching and research in a north central land-grant college. Age 25-35. MS deg in agricultural engineering, or work nearly completed for such degree. Experience in teaching and research as instructor or graduate assistant. Usual personal qualifications for college teaching. Permanent position in growing department. Salary open. O-372-759

IMMEDIATE OPENING for eastern territory sales representative with leader in sprinkler irrigation equipment field. Only applicants experienced in irrigation sales field or qualified specialists in allied lines need reply. Car furnished. Salary and expenses. Bonus. O-384-760

NEW POSITIONS WANTED

AGRICULTURAL ENGINEER for research, teaching, writing, or sales and service in power and machinery. Any location in USA, or Middle East. Married. Age 37. No disability. BS deg in mechanical engineering, 1940, Superior Technical College, Tehran. MS deg in agricultural engineering, 1951, Ohio State University. Foreign languages, Persian and French. Drafting and designing, 2½ yr; cost estimating and maintenance 4 yr, Tehran, Iran. Agricultural engineering experience, trainee one year installing farm equipment and irrigation pumps in California; selecting farm equipment and doing extension work in Iran, 15 mo. Available now. W-351-41

AGRICULTURAL AND MECHANICAL ENGINEER for group leader, or design and development responsibility in power and machinery field. Married. Age 32. No disability. BS deg, University of Wisconsin, 1947. Postgraduate work mechanical engineering one year. Armed service 3 yr. Agricultural engineering research, USDA, 2½ yr. Research, development and product design with large Midwest manufacturer, 5 yr. Experience in harvesting and industrial equipment design. Approximately 35 patents and applications pending. Farm background. Available on 30-day notice. Salary $9,000-$10,000. W-369-42

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Professional Directory

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